THE IRON TRADE REVIEW

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THE IRON TRADE REVIEW.

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CLEVELAND, O., JUNE 4, 1890.

THE WEEK IN IRON CIRCLES.

General Features. The May 1 statement of the steel rail pool shows sales for the first five months of 1890 of 1,020,023 gross tons, and the deliveries 550,000 tons. This it at the rate of 825,000 tons for the first half year, as against 642,653 tons for the similar period of last year. This indicates a very healthy state of the steel rail trade. The annual meeting of the iron and steel workers is in session at Pittsburgh as we write, with the results yet to be determined. The English iron market continues in a depressed condition. Our correspondents, S. W. Royce & Co., Manchester, write under date of May 24: "While Scotch pig iron stands at about the same level as at the beginning of the month, Middlesbrough warrants have fallen about 3s. 6d. per ton, and are now at about 4s. per ton less than Scotch. The makers in the Middlesbrough district, who have been holding off in the strong feeling that the reduced prices could not last, are now coming forward and meeting the market, and under circumstances the present position is not a good one. There is not much business doing, and what there is is only for present delivery." The situation in the Central West is outlined below: Activity at low prices has been the ruling feature in Cincinnati for some weeks past. It is even more pronounced as the present week closes. Every seller of Southern iron has had all the business he could take care of, and a great deal has been refused at full current prices. Furnaces hesitate to formally advance prices until they are sure the position can be maintained all Summer. It looks, however, as though that point would be reached early in June, as nearly all the producers are full of orders for one to four months ahead of make. The inquiry for charcoal irons and Ohio softeners is also better. Prices are firm all along the line, and the tendency toward an advance is pronounced. Wm. F. Jarvis & Co., Detroit, report that nearly every grade of pig iron continues to show increased firmness. As was anticipated last week, there were a number of large sales of Lake Superior charcoal, aggregating several thousand tons, but notwithstanding this, there is still left unsatisfied to-day a larger inquiry than at any time during the year. Prices are firm and concessions will not be made by the furnace-men. The same conditions may also be said to apply to Southern foundry and forge irons, although the volume of business was not as large, only foundry grades being needed. All sellers are sanguine of a continued better market. The market at Louisville is showing a firm tone and buyers are purchasing freely for long delivery. Furnaces have continued to sell at figures current recently, and among the leading furnaces there has been no advance in prices; the tendency, however, is toward a slight increase, and it is thought this will be realized shortly. One or two furnaces who have been virtually out of the market for the last month, having held at $10.75 for grey forge, Birmingham, are now able to place their iron more freely. It is thought the coming week will show large sales, and were it not for the heavy production, a sharp advance. Furnaces believe that the coming month will show iron fifty cents higher, and while disposed to sell a portion of their product at present prices, do not wish to encumber themselves with an unusual amount. The market is strong at Pittsburgh, with an advancing tendency. Bessemer is about fifty cents per ton higher than it was a week ago, and the demand is active. Mill and foundry irons are in good request, but without much change in price. Furnace-men are generally unwilling to contract very far ahead. Instead of the dullness common in the Chicago market at this period of the year, there is unusual activity. Buyers are rather more plenty than sellers at current minimum prices. The bargains that were going in Southern irons have disappeared. Local brands also are firmer. Lake Superior charcoal irons are so well grounded, on what the makers consider bottom, that offers on large lots at fifty cents per ton under asking figures are promptly declined. Business at St. Louis continues fair at unchanged prices. No large orders are reported during the past week.

Iron Ore. The reports under this head which, during the past two or three weeks, have appeared in these columns, seem to have given rise to a great deal of criticism in the Lake Superior country. Some of the opinions advanced go to the extent of charging inconsistency for "first giving utterance to the prediction that the 1890 output would be 9,000,000 tons," and then "suddenly lowering the figure to 7,000,000." As a matter of fact, no 9,000,000 output was ever predicted in these columns, any more than a 7,000,000-ton output. Six months ago, the very large and unexpected sales—if, indeed, they presaged anything at all—indicated a considerable increase in the 1890 output over that of last year. The state of the market warranted dealers and producers in expecting an increase for the current season of 25 per cent. and, voicing these opinions and expectations, without any home-made additions, these statements were sent abroad as being the opinions of the iron ore dealers. A little later, a retrograde movement set in which lasted for five months or more, and it is not to be wondered that the dealers in iron ore underwent a change of opinion as to the business of the year. A local firm of ore men, doing the largest business on the chain of lakes, is authority for the statement of two weeks ago that, "unless the daily receipts between this (that) date and July 1, shall be very considerably augmented, the total receipts of 1890 will fall below those of 1889." Well, July 1 is still four weeks off, and there is no good reason for modifying the above opinion. There is so far an increase over last year's shipments of 300,000 tons, but the peculiarity of this increase is remarkable, in this, that it all comes from the Gogebic region, while there is no increase in the shipments from any of the three older ranges. Whether or not this increase of shipment in Gogebic ore is due to the easier handling of hematites, remains to be seen. Nobody denies the fact that some mines have been unable to get into their stock piles to the extent of shipping facilities, and it may be set down unless some 800,000 tons of non-Bessemer ores, yet unsold, find an early market; that tonnage will not be brought down, whether it is mined or not. The docks are now overcrowded with ore, and the rail shipments seem to make little impression upon this vast accumulation. The month of July will tell the tale as to the business of the current season. Very little has occurred in the market, during the week, in the way of ore sales, but the Republic Iron Company has purchased the West Republic mine, into which the Republic ore dips. The price was $5 per share, and of the 20,000 shares all but two hundred changed hands. The demand for Bessemer ore is good, but sales are still backward.

Pig Iron. The market is steady and quite firm. Some sales have been made at going prices, but the initiative came from the purchasers, and no concessions are being made by furnace-men. Undoubtedly the firm position taken by makers of pig iron has given the consumers renewed confidence, for there is no lack of inquiries which, for the most part, are refused. It is unnecessary to add that the iron made from new ore costs just about a dollar a ton more to make than when made from '89 ore, so that the furnace interests are not one whit better off than before, after advancing the price $1. Still, the tendency is in the upward direction, and the furnace interests who declined to sell at the April and May prices are in a good position to realize a little later on.

A NOTABLE GATHERING OF IRON AND STEEL MEN.

From Mr. C. Kirchhoff, Jr., Secretary of the American Reception Committee, we are in receipt of very full information regarding the approaching visit of foreign iron-masters and engineers to the United States, as the guests of the American Institute of Mining Engineers, the American Iron and Steel Association, the American Society of Civil Engineers, the American Society of Mechanical Engineers, and the United States Association of Charcoal Iron Workers. The foreign societies accepting invitations are the British Iron and Steel Institute and the Verein Deutsch Eisenhuettenleute. Among the 300 members of the former organization who will attend the joint meetings in this country are the President, Sir James Kitson, Bart., Sir Lowthian Bell, Bart., F. R. S., Lord Edwin Cavendish, M. P., G. J. Snelus, F. R. S., Frederick Siemens, Sir Thomas Storey, and others whose names will be recognized as among the leaders in the British iron trade. Among the 150 Continental visitors we notice the names of influential engineers and iron-masters from Germany, Austria, Spain, Italy and Switzerland. The American Reception Committee consists of Andrew Carnegie, Chairman; George A. Crocker, New York, Treasurer, and C. Kirchhoff, Jr., Secretary, together with a Central Committee of 50 and a General Committee of about 150. On the former we notice Hon. Abram S. Hewitt, President, and Dr. R. W. Raymond, Secretary of the American Institute of Mining Engineers; B. F. Jones, President, and J. M. Swank, Manager of the American Iron and Steel Association; W. P. Shinn, President, and James Bogart, Secretary of the American Society of Civil Engineers; Oberlin Smith, President, and F. R. Hutton, Secretary of the American Society of Mechanical Engineers; W. N. McGugin, President, and John Birkinbine, Secretary of the United States Association of Charcoal Iron Workers; J. C. Bayles, Dr. T. Sterry Hunt, O. W. Potter, Henry S. Pickands, J. F. Holloway, Wm. Chisholm, Samuel Mather, Gen. Fitzhugh Lee and Ferdinand Schlesinger. On the General Committee occur, among others, the names of Wm. Sellers, Lewis Miller, Thos. A. Edison, M. A. Hanna, George H. Ely, Smith M. Weed, Joseph L. Colby, T. C. Platt, R. H. Thurston, Samuel Thomas, S. T. Wellman, J. P. Witherow and H. C. Frick.

The foreign guests will arrive at New York, in different steamers, toward the close of September. Many of them will attend the New York meeting of the American Institute of Mining Engineers, on September 29 and 30. The first technical session of the British Iron and Steel Institute and the formal reception of visitors, will be held on Wednesday, October 1. During the stay in New York the statue of the distinguished engineer, Alexander L. Holley, will be unveiled. The visitors will then start westward, stopping at Philadelphia, Lebanon, Harrisburg, Altoona, Johnstown and Pittsburgh. At Pittsburgh two international sessions will be held, and papers will be read by the most distinguished American and foreign engineers. From Pittsburgh the party, consisting of over 1,000, will go to Chicago, by way of Youngstown and Cleveland, arriving in this city on Monday, October 13. At Chicago the party will divide into two groups, one going to the Lake Superior country and returning by the Sault Ste. Marie Canal and Niagara Falls, and the other making a tour of the Southern iron districts, returning by way of Washington.

GAMBLING IN IRON WARRANTS.

Following the action of the British Iron Trade Association, in appointing a committee to suggest a remedy for the evils growing out of speculation in pig iron warrants, the London *Iron and Coal Trades Review* publishes the opinions of several leading iron-masters regarding the matter. These opinions consume a page and a half of the *Review*, and are all one way—condemnation of the system in its natural and inevitable results. As the American promoters of pig iron speculation have endeavored to explain away the various extracts we have from time to time given from the leading British trade papers, by saying that it is to the interest of the foreign iron-masters to discourage the accumulation of pig iron stocks on this side of the ocean, it may be well to revert to the subject in order to demonstrate that the criticism of the system is directed toward evils from which the British iron trade is actually suffering and has no bearing whatever upon the American market. Indeed, in all that is said on the subject by the London paper and its correspondents we do not observe a single expression that hints at any interest in the question as related to the United States. It is purely a local question, and as such the opinions quoted are of value to American iron-masters, who are continually solicited by letters and agents to go into the scheme but who, except to a very limited extent, have thus far sensibly held aloof.

In the first place, the British iron manufacturers seem to be united upon the point that ordinary dealings in warrants are a necessary evil—no better and no worse than any speculation on future prices may be, whether in grain, real estate, or manufactured stocks. The objectionable part of the system, as very clearly set forth by a gentleman who has long been prominently connected with the iron trade of the Cleveland (England) district, is that those who buy or sell do not trust to the trade being influenced by legitimate causes, such as supply and demand for actual use, but upon artificial and too often disreputable means for violently stimulating or depressing the market. "The gambler," says this outspoken correspondent, "depends upon other means to bring about the end he has in view; if he is a 'bear' he does his best to depreciate the market, and if a 'bull' to inflate it, without regard to prime cost or consequences to others, and a lot of trickery is resorted to for this purpose. This is the pernicious part of the business, and is strongly to be condemned."

The writer gives as a recent instance the case of a Glasgow operator who, to "bear" the market, waited with his eyes fixed on the Exchange clock, until a few seconds before it struck the closing hour, and then made an offer for a large parcel of iron much below the rates that had prevailed all through the day. This offer he drawled out to such length that it was impossible to accept it before the clock had struck; and this fictitious price, purposely made so as not to give opportunity for its acceptance, stood as the closing figure of the day, and was thus cabled to all parts of the world.

Another correspondent, a Cleveland ironmaster, states that he considers the public stores a great evil, and that the sooner they are done away with and not renewed the better, for the trade will be all the stronger for it. Still another iron manufacturer attributes the recent collapse in the English iron market entirely to the manipulations of people not connected with the trade. A fourth ironmaster says that he knows of "one contract for 25,000 tons of pipes for Colonial water works that could come to Cleveland, but the people will not place it, while the market is unsettled by the operations of the gambling fraternity." A fifth says: "Large fortunes have been made by the 'knowing ones.' The losses have fallen on a wide constituency of dupes, of which on every such occasion there is a large crop. * * * The result has been a total disorganization of the business. The maker cannot sell without heavy loss at the market price for warrants, and the consumers have had their business arrangements so deranged that they are afraid to buy, under the apprehension that prices will yet be forced down further."

The remedies proposed are: (1) that contracts shall hereafter only be made for iron warrants which are actually held, and of which the numbers shall be given; (2) that if sellers use fictitious numbers the buyer may, if he choose, lawfully repudiate the contract, and the buyer or seller discovered in engaging in such transactions shall not be allowed to enter into any iron contracts on 'Change; (3) that the Cleveland ironmasters buy up all the warrants that are available in the local public stores; (4) that an end be put to public storing altogether. It cannot be denied that any of these proposed remedies are radical enough. That they are radical is the best evidence that the evil is great, and far-reaching. Do American iron manufacturers want to plunge into the same unhappy experience, with the same inevitable and calamitous results?

CANADA'S STRUGGLE TO ESTABLISH AN IRON INDUSTRY.

To the courtesy of the Minister of Agriculture of the Dominion Government, through Mr. J. J. Cassidey, editor of the *Canadian Manufacturer*, we are indebted for an advance copy of the "Report of the Royal Commission on the Mineral Resources of Ontario and Measures for their Development," just issued from the press. The Commission is composed of John Charlton, M. P., Robert Bell, M. D., LL. D., Assistant Director of the Canadian Geological Survey, William Coe, explorer and miner, William Hamilton Merritt, F. G. S., Associate Royal School of Mines, and Archibald Blue, Deputy Minister of Agriculture and Secretary of the Bureau of Industries of Ontario.

The report covers a wide field of observation and presents a vast amount of very interesting and valuable data. Nor does it stop with an enumeration of the mineral resources of Canada, and the disastrous record of its failures to establish an iron smelting industry, but it goes into the question of causes and remedies with a candor most refreshing. Among the measures for aiding and encouraging the mineral development of the Dominion, it suggests the organization of a Provincial Bureau of Mines, mining schools, local museums, etc.

Finally, it comes out flat-footed for reciprocity with the United States, as the one economic measure essential to the establishment of an iron mining industry in the Queen's dominions. It shows that the cost of transportation of Canadian ore to Cleveland, Ashtabula or

Pittsburgh is not greater, and in some cases is slightly less than from the mines of northern Wisconsin and Michigan to the same points. It adduces the testimony of numerous owners of mineral lands to demonstrate that, with the removal of the American duty on iron ore and the Canadian duty on mining machinery, the development of an iron mining industry in the Dominion would be as good as accomplished. We shall have occasion to quote from some parts of the report hereafter; in the meantime, we are inclined to think that the Commission entirely misjudges the situation on this side of the border when it counts upon the removal of the iron ore duty as a possibility of the near future. In fact, no section of the McKinley bill is more likely to remain as it is than that which continues the duty at 75 cents per ton. And there is good reason for this in the very argument which the Commission bring forward, viz.: that, with the duty removed, Canadian ore could be laid down at Lake Erie ports and Chicago in direct competition with Lake Superior mines. We have a very friendly interest in Canada, but it is too much to ask us to surrender the interests of American capital, labor and shipping just to help out our Northern next-door neighbor.

PRICES UNDER PROTECTION.

Mechanics are interested in the price and efficiency of tools, as all heads of families are in the cost and utility of articles of household hardware and cutlery. Once all these were imported. Their home manufacture has been fostered by a protective tariff in the face of an opposition as vigorous as it was untiring, until to-day the United States is well up on the list of nations exporting certain lines of hardware, in which superiority of finish and durability in use are prominent recommendations.

A few years ago, a select committee of the British parliament, after careful investigation, enumerated 42 articles of hardware and machinery, in the selling of which Americans had largely superseded English manufacturers in certain markets, including some of the British colonies. Many of these articles, such as axes, scissors, penknives, lamps, coffee mills, nails, clocks, watches, tableware, etc., are those common and necessary to every family. The list also included such farming implements as buckets, corn crushers, cultivators, cotton gins, hay rakes, hoes, mowing machines, scales, etc.

It can thus be seen that British statesmen and manufacturers have found out that protection in the United States has not made prices too high for outsiders to buy, no matter what their agents in this country may contend in their efforts to have our markets opened to unrestricted foreign competition. And in its demonstration of economical production under protection is to be found the chief value of the fact cited by the parliamentary committee. It must not be permitted to lure voters from a recognition of the fact that the foreign market is necessarily restricted by the limited wants and the poverty of buyers, as well as the desperation of those competitors whose trade is thus menaced. No foreign demand for American manufactures can be made to compensate for the privilege of supplying the home market. With a certainty of this home market, at prices consistent with the payment of fair wages to employes, competition between American manufacturers will always insure to American buyers the best of products on terms within reach of all.—[Illinois Branch American Protective Tariff League.

Iron and Coal in Manitoba.

While people look on Manitoba as a country suitable for farming and stock raising, yet there are other, and especially mineral, resources of great value. Coal is found in large quantities in southern Manitoba, and will be on the market, this year, at a low rate. We have also an immense deposit of the choicest iron ore awaiting development. The deposit of iron on Black Island, in Lake Winnipeg, is extensive enough to supply us with all the iron necessary for manufacturing purposes for many years to come, no matter how large this country may grow. Assays show it to be of the first quality. There are in this deposit millions of tons, chiefly of a species of brown hematite. A surface sample assayed by J. F. Latimer, Winnipeg, gave 62 per cent. metallic iron, and he states the ore a self-fluxing one.

Now, with these advantages at our door why is this not taken up by capitalists, it cannot be known to them or else it would not have been dormant so long. The time is coming very soon when iron ore will be produced in such quantities in Manitoba as will bring the country still more to the front, for with iron comes all classes of manufactures, which is what we require to make Manitoba a country second to none on the continent. Pig iron can be produced in Manitoba for $12 a ton, and this is reduced to $10.50, through the Government bonus. In Montreal pig iron costs $28 per ton, and in Winnipeg $38 per ton. It is a vast loss to this province that this ore is not utilized to supply the growing demands of the country, and for which we have to pay so heavily to Eastern manufacturers.—[Colonist, Winnipeg, Can.

IN machine shops it is a frequent occurrence that particles of metal penetrate in the skin and eyes. Messrs. Frister & Rossman have, according to *Revue Industrielle*, constructed a magnet for the special purpose of extracting such particles. It is horseshoe-shaped, polished and nickel-plated; the two branches are rounded off and end in a point only a few millimeters thick. Its attraction for iron extends for several millimeters.

AN extra exhibit of Colorado minerals will be sent to the London (Eng.) Exhibition, the matter being now under consideration by the Denver Mining Exchange and Chamber of Commerce.

THE FREEZING PROCESS IN SHAFT SINKING.

BY DANIEL E. MORGAN, C. E.

The freezing process for making excavations in water-bearing material was employed for the first time in the United States at Iron Mountain, Mich., in sinking a shaft for the Chapin Mining Co. The Chapin mine is well known as the largest producer of Bessemer ore in the Menominee district. The strike of the main ore body is, roughly speaking, at right angles to the axis of the valley in which the workings are located. The outcrop is only slightly covered with soil on the side-hills, but in the swampy centre of the valley it is heavily overlaid with drift. The first opening, a slope following the dip of the ore, was made near the original discovery, high up on the side-hill. Subsequently shafts were sunk through the overlying rock to the ore at points further down the hill. As the workings were pushed out from these shafts, under the swamps, and toward the centre of the valley, new shafts were needed for ventilation, to shorten underground and surface haulage, and also to enable the mine to be drained at the point where the lift of the pumps would be at a minimum. For all these purposes, the most desirable location for a shaft was the centre of the valley. But the difficulty of sinking increased as the location of the shaft left the hillside and entered the swampy bottom lands.

The material overlying the rock in the central part of the valley is largely fine sand, having a little clay mixed with it. In the presence of water this material is very unstable; as the miners put it, "it will run where water will," and it is very destructive to pumps. Through this occur layers of gravel and boulders. Many of the boulders are of large size, and so closely packed as to give the effect of having been laid by a mason.

The mining company made several attempts to get a shaft down through this swamp, but failed entirely, only demonstrating the difficult nature of the undertaking. Finally, in 1887, a contract was entered into with the Poetsch-Sooysmith Freezing Co., the owners of the American patents covering the freezing process, by which the latter agreed to sink a shaft of circular section to the ledge at a point where the overlying material was about 100 ft. thick.

The location selected for the shaft was in the centre of the valley, close by the small stream which carries the surface drainage of the small tributary

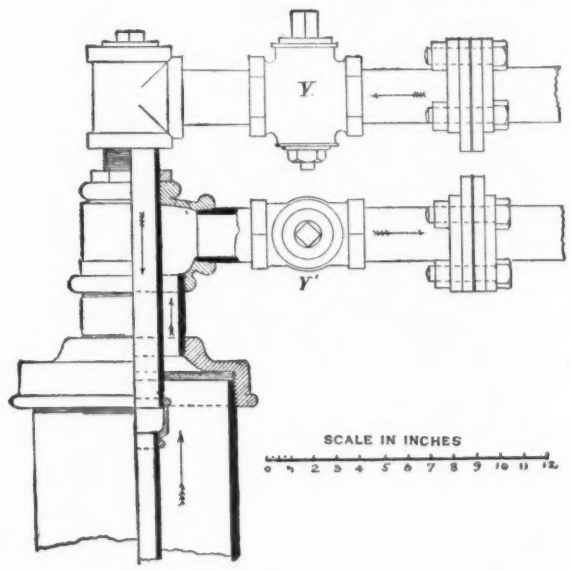


FIG. 1.

water-shed. It was, therefore, at the lowest level possible. In reference to the ore-body, it was located so as to go down in the country rock on the foot-wall side, the experience of the mining company having been that shafts going through the hanging-wall are short-lived. Trial borings showed that the drift overlying the rock was 95 ft. thick at the centre of the shaft, and that the water level stood to within 10 ft. of its surface. This water level was below the normal, having been reduced by pumping operations at neighboring shafts, and subsequently varied considerably from the same cause.

Preliminary Work.—The original design was for a shaft circular in section, with lining of cast-iron plates.* On this basis it was decided to sink 26 8-in. pipes vertically through the drift to the ledge, so arranged in plan as to be equally spaced around a circumference of a circle of 29 ft. diameter. The pipes had to be nearly vertical, absolutely tight under pressure, and their lower ends had to be securely closed. It was decided to be impracticable to sink these pipes independently and have them fulfil the requirements, so 10-in. pipes were sunk first, to serve as temporary casings, inside of which the 8-in. pipes were put into position with safety.

As soon as a 10-in. pipe was in position, with its lower end some inches into the ledge, a line of 8-in. pipe was lowered into it, the first section having previously had its lower end closed by welding in an iron plug. The 8-in. pipe was made of ⅜-in. iron plate, the sections going together with male and female taper screws cut out of the thickness of the pipe, making a flush joint inside and out. As each joint was made, it was tested under heavy water-pressure, and if tight the line was lowered the length of a section, and the next joint made and tested; and so on until the entire length was completed. Then the 10-in. casing was drawn with use of water-jet, leaving the 8-in. pipe in contact with the soil. In this way, 26 lines of 8-in. pipe, varying in length from 87 to 97 ft., were put in position. This part of the work was one of great difficulty, owing to the number and size of the boulders encountered. Under the terms of the contract it was done by the Chapin Mining Co., and upon its completion the

*This was subsequently changed by the Chapin Mining Co. to a timber lined shaft of rectangular section.

work was turned over to the Freezing Co., by whom all subsequent operations were conducted.

Refrigerating Machines and Connections.—A Linde ice machine (ammonia compression type), of 50 tons refrigerating capacity, *built by E. W. Wolf, of Chicago, was put in position close by the circle of pipes. The motive power was furnished by an Allis-Corliss engine, connected with the ammonia compressor of the refrigerating machine by a shaft carrying a heavy fly-wheel. The engine was 18″x42″, used compressed air† at 60 pounds pressure, and developed 55 H. P. at 60 R. P. M.

The ammonia compressor was of simple design and had ample bearing surfaces, so that a seven months' run was completed without any shut down for repairs or hot bearings. It is much to be regretted that no test was made of the efficiency or capacity of the machine under the conditions existing at Iron Mountain, as it would have been of great interest to know the total number of heat units taken from the soil to compare with calcutions based on the observed effects.

The brine used as vehicle between the refrigerating machine and the soil was a solution of the impure $CaCl_2$ of commerce. According to an analysis furnished by the manufacturers, the "chloride of calcium" contains:

	Per cent.
$CaCl_2$	60
NaCl	5
MgCl	15
H_2O	20

A saturated solution of $CaCl_2$ is said to have a freezing point of 40 degrees Cent. (or Fahr.). No trouble from freezing of the brine was experienced at the temperatures used at Iron Mountain, except when the specific gravity of the solution was below 1.200. The cold brine was pumped through a set of distributing pipes and regulating valves to the ground pipes. After traversing the ground pipes it returned through a set of collecting pipes, similar in arrangement to the distributing pipes, to the refrigerating machine. The circulation of the brine in the ground pipes was effected as follows (see fig. 1):

Each 8-in. ground pipe was capped with a 8″ to 4″ reducing coupling, and this connected by a short 4-in. nipple, with a 4″x2″x2″ tee. The 2-in. side opening of this tee connected with the return system. Through the 2in. top opening ran a "long threaded" 2-in nipple with jamb nut above. This nipple extended some 18 in. below the 4″x2″x2″ tee, and was there connected by a 1½″x2″ reducing coupling with a line of 1½-in. pipe extending down the center line of the ground pipe to within a few inches of the bottom. The upper end of the 2-in. "long threaded" nipple was capped by a 2″x2″x2″ tee, from the side of the opening of which connection was made with the distributing system. The brine entered through the top connection, passed down through the line of 1½-in. pipe to the bottom of the ground pipe, returning through the annular space between the 1½-in. pipe and the 8-in. pipe, and going out through the lower 2-in. side connection.

The circulation of the brine through each pipe was adjusted by means of regulating valves, V and V_2, Plate I, so as to bring the temperature of the return streams as nearly equal as possible. This method of regulation was lesigned to render the effect of each pipe equal in the event of the conditions affecting the pipes being different. The velocity of the brine in the inner down-flow pipes was 2 ft. per second, the brine changing every 25 minutes in the ground pipes.

The connecting pipes above were not protected in any way, so that immediately after starting, the condensation ofmoisture from the atmosphere coated the pipes and connections with a snow-like ice, which increases in thickness until some very picturesque effects were produced. The coating, moreover, serves as a cheap and effective lagging.

The effect of starting the ice machine and the circulation of brine was immediately apparent. The ground froze around each pipe, forming cylinders (or, as they were afterward found to be, cones,) which increased in diameter until adjacent cylinders intersected, thereby forming a continuous circular wall extending from the surface of the ground to the underlying rock, and constituting a coffer-dam inclosing the proposed shaft. The rate of freezing around the shaft was substantially uniform.

On excavating down to and below the water level, the wall was found to be complete and tight under pressure, and no water at any time came through the frozen wall, although, as subsequently to be described, water did find its way through the rock ledge, and finally between the ledge and the base of the frozen wall. As the excavation progressed, the diameter of the core of unfrozen material in the center of the shaft decreased. This was due primarily to the difference in elapsed time, but also in some degree to an effect of the method of circulation. The brine being introduced through small pipes in the center of the 8-in. ground pipes, it reached the bottom at nearly its initial temperature, so that the lowest temperature, and consequently the greatest freezing effect was at the bottom of the shaft. With a nearly constant difference of only 1 degree Cent. between the top and bottom of the pipes, there was a marked difference in the distance frozen, as determined at the completion of the work by means of a small trial shaft sunk on the outside of the wall, which showed a nearly uniform batir of about 1 in 15. It was not determined, however, that this increased thickness was due to this cause alone.

It is apparent that the difference in temperature between top and bottom of the pipes, and probably the extent of this coning could be regulated by varying the rate of circulation. There is a theoretical advantage in the cone form, as the pressure on the frozen wall increases directly with the depth. On the other hand, the difficulty of excavation increases as the wall thickens and the unfrozen core diminishes in diameter.

The rate of freezing varied in different materials, according to the amount of water contained. Several careful experiments gave 16 per cent, of water in the fine sand. Where gravel or boulders were imbedded in the sand, this percentage was largely decreased and the distance frozen was correspondingly greater.

The effect of the water can be seen from the following approximate calcu-

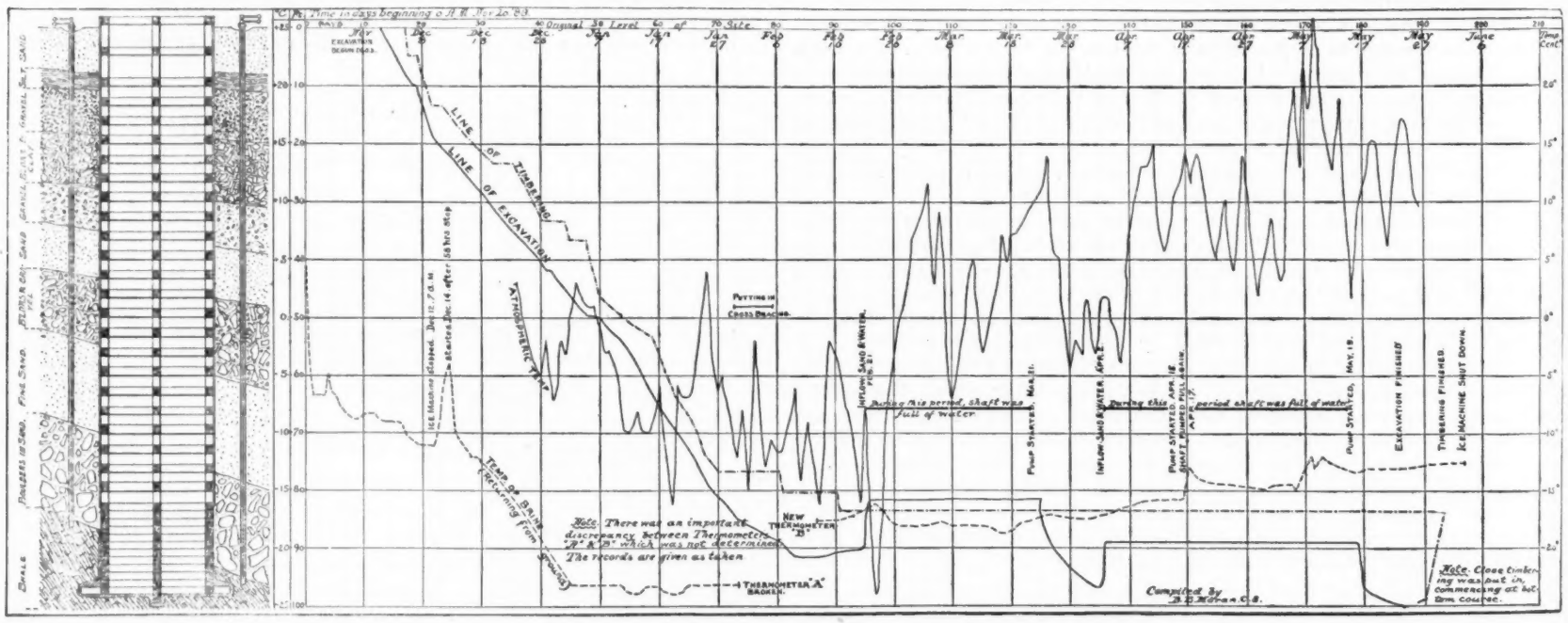

Time in days beginning
Original Level of Site
LINE OF TIMBERING
LINE OF EXCAVATION
ATMOSPHERIC TEMP.
Temp of Brine returning from ground
Putting in Cross Braces
Ice Machine stopped. Dec. 12, P.M.
Started Dec. 14 after 58 hrs stop
Inflow Sand & Water, Feb. 21
During this period, shaft was full of water
Pump Started, Mar. 31.
Inflow Sand & Water, Apr. 2
During this period shaft was full of water
Pump Started, Apr. 16
Shaft Pumped Full Again Apr. 17
Pump Started, May 19.
Excavation Finished
Timbering Finished.
Ice Machine Shut Down
Thermometer "A" broken.
New Thermometer "B"
Note. There was an important discrepancy between Thermometers "A" & "B" which was not determined. The records are given as taken.
Compiled by
Note. Close timbering was put in, commencing at bottom course.

FIG. 2.—SHAFT-SINKING AT THE CHAPIN MINE—PROGRESS DIAGRAM.

lation of the number of heat units required to reduce the temperature of one cubic yard of saturated quicksand from 10° Cent. (50° F.) to —15° Cent. (5° F.), limits which agree with practice for material in close proximity to the freezing pipes:

		Pounds.
One cubic yard of saturated sand, as determined by experiment, weighs		3,360
Weight of water, 17 per cent		571
Weight of sand, 83 per cent		2,789
Specific heat of water	1.0	
Specific heat of sand	0.2	
Specific heat of ice	0.5	
Latent heat of ice	80	Cent. lb. h. u.
Heat units abstracted from the sand:		
Weight X sp. ht. X range of temperature	=	C nt. lb. h. u.
2,789 X 0.2 X [10 — (— 15) = 25]	=	13,9 5
Heat units abstracted from contained water:		
1. To reduce to 0° Cent.		
Weight X sp. ht. X range of temperature	=	Cent. lb. h. u.
571 X 1.0 X 10	=	5,710
2. To freeze.		
Weight X latent heat		
571 X 80	=	45,680
3. To reduce to — 15° Cent.		
Weight X sp. ht. X range of temperature		
571 X 0.5 X 15	=	4,282
Total	=	55,672

SUMMARY.

Heat units in sand = 79.97 per cent	13,945
Heat units in contained water = 20.03 per cent	55,672
Total	69,617

Or the water in the sand consumes nearly 80 per cent. of the refrigerating effect. If, then, the sand be replaced in part by material not containing water, the work of freezing will be proportionately reduced.

The above figures do not represent the amount of freezing effect required to produce a cubic yard of frozen wall in practice. Besides the loss due to radiation above ground, the following causes produce greater or less losses:

1. Conduction from subterranean sources of heat.
2. Conduction from surface.
3. Flow of subsoil water.

It must, however, be remembered that the work of refrigeration, as dis-

*One ton refrigerating capacity, is equivalent to the cooling effect of one ton of melting ice, or 2,000 pounds X latent heat ice, = 2,000 X 142 + = 284,000 + British thermal units.

†The power used at the Chapin mine is furnished by an air compressing plant at the Quinnessec Falls of the Menominee River, distant about three miles. For a brief description of this interesting plant, said to be the largest of its kind, see Catalogue of the Rand Drill Co.

tinguished from the work of freezing, includes the cooling of a quantity of material beyond the limits of the frozen wall.

Characteristics of Frozen Quicksand.—The character and strength of frozen sand will probably be found to vary with different sands. The sand at Iron Mountain was very fine, and to the eye and touch it seemed to be composed of grains of fairly uniform size, without sharp edges. Under a low power microscope, however, the size of the grains is seen to vary from a maximum of about $\frac{1}{64}$ of an inch for the greatest dimension down to what still appears under the glass to be a mere speck. The angles of the grains appear as sharp as in ordinary building sand, but the grains are not clean, and there is slight tendency to cake. A sample taken from the center of a lump, as excavated, and tested for size of grain gave the following results:

One hundred grammes were weighed, and of this

1.8	grammes	were	stopped	by an	80	mesh	screen.
2.0	"	"	"	"	100	"	"
26 6	"	"	"	"	193	"	"
68.7	"	passed			190	"	"
.9	"	were lost.					

100.0 total; or nearly 70 per cent. passed a 190-mesh screen.

Tests were made during the progress of the work to determine the strength of this material when frozen. Briquette molds were filled with saturated sand and frozen, the resulting briquette being kept at a low temperature until tested. An ordinary Fairbanks cement tester was used for both tensile and compressive tests. The compressive tests were limited by the size of the machine to one-inch cubes, which were formed roughly by the same method used for the tensile strength briquettes. The tests were made in a cold room, but the temperature of the test pieces was not determined, nor is it known what effect, if any, the degree of cold below 0 degree Cent., has on the strength of the material. The results were as follows:

	Tensile Strength.
Average of 4 tests	431 lbs. per sq. in.
Maximum result	491 " " " "
	Compressive Strength.
Average of 8 tests	575 lbs. per sq. in.
Maximum	880 " " " "

Frozen quicksand can be regarded as a mortar in which the cementing material is ice, and, as in a cement mortar, the strength will probably be found to depend on the quality of the sand and the presence of sufficient cementing material as well as on the strength of the cement. When unmixed with gravel frozen quicksand looks like a fine-grained sandstone; it is perfectly homogeneous, breaks with a tendency to conchoidal fracture, and is as hard to work as a stone of similar character. When the sand contains gravel or boulders the difficulty of working is more than doubled, as the gravel increases the tenacity of the mass and continually dulls the pick-points and "moils" of the miners. The strength with which the quicksand adheres to the stone is shown by the line of fracture in such material. There seems to be no tendency for the rounded boulders to pull out of the quicksand, but rather for the break to follow. Fig. 5 shows the rock ledge and the base of the frozen wall, the line of junction between the two being marked at one point by the miner's candlestick. The upper part of the engraving shows pieces of rock detached from the ledge embedded in the quicksand. The vertical dark lines on the surface of the wall of quicksand are tool marks.

Excavation.—The progress of the excavation and timbering is shown by the accompanying diagram (Fig 2), which also shows the variations in temperature of the atmosphere, and of the brine returning from the ground. On the fifteenth day after starting the ice machine, excavation was begun with two gangs, working ten hours each. On the twenty-third day the supply of compressed air for the engine of the ice machine failed, and for sixty hours the ice machine was idle while a connection to an adjacent steam-boiler was being made.

During this time excavation was suspended, and the temperature of the brine rose. Excavation and timbering was resumed on the twenty-eighth day, and continued without interruption until the seventy-fourth day, when cross-timbering was begun. This occupied four days, during which time but little excavation was done.

At this time, and for ten days previously, a small amount of water found its way into the shaft, coming up through the unfrozen core. As the excavation progressed this increased in amount, so that a small pump was placed to keep the shaft dry. At first no sand came with the water, and no difficulty was occasioned, but on the 93d day the water increased in quantity and sand began to come with it. Additional pumps were put in position, but as the flow of sand greatly increased, the shaft was pumped full of water to equalize the pressures inside and out, and thereby prevent any further flow, until the leak could be frozen off.

The reason (as was subsequently demonstrated) for the flow of water and sand is this: As the excavation progressed, the unbalanced water-pressure outside caused a small amount of water to pass through seams in the ledge into the unfrozen center of the shaft. This flow of comparatively warm water gradually heated up the partially frozen ledge and opened new passages, increasing the flow and ultimately thawing the base of the frozen wall. A direct passage was then afforded between the frozen wall and the ledge, through which came sand and water in increasing quantities. The opening enlarged constantly, rendering a shut-down imperative.

In order to close this leak expeditiously an additional freezing-pipe was put in place inside of the shaft and near the location of the leak. The pipe was jetted down into position, and brine circulated through it continuously. On the one hundred and twenty-fifth day the shaft was unwatered, and excation begun again, only a small quantity of water coming in. The sand which had come in with the water was speedily removed, together with tons of ice which had formed on the walls of the shaft.

Sinking was then resumed with three shifts working eight hours, and good progress was made until the 135th day, when the flow of water through the old leak increased rapidly, driving the men up and necessitating a second shut-down. The sump was at that time 7 or 8ft. in the rock, consequently below the leak, which was at the line of junction between the rock and the sand.

Before flooding the shaft a coil of pipes was suspended against the wall exactly at the leak, and pipe connections were carried from the coil to the surface, and connected there with the circulation of brine. In this way the freezing action was concentrated at the known point of weakness.

Then followed a short period of freezing and trial pumping until May 15 (the 178th day) when the shaft was pumped out for the last time. The leak

FIG. 5.—SHAFT-SINKING AT THE CHAPIN MINE—BASE OF WALL OF FROZEN QUICKSAND.

Engraved from a flash-light photograph, taken at midnight, 90 ft. below surface of ground. The miner's candlestick marks the junction of the ledge with the frozen quicksond.

was found to be effectually closed, and the excavation was completed without further difficulty.

Lining.—The timbering was put in position by the regular gang of miners after all the framing had been done on the surface. The first and uppermost set of timbers was hung from heavy sticks which extended along two opposite sides of the shaft, and which were sufficiently long to get a solid bearing at each end 6 ft. back from the edge of the excavation.

As the timbering progressed, each set was hung by links and screw-bolts from the one immediately over it. Only the main timbers and the 4-in. lagging were put in position at first, the cross-timbers (or "dividers") not being put in until the timbering was nearly completed, and then in reversed order, beginning at the bottom and working up. The operation of putting in a set was as follows: The set having been framed, assembled and marked above ground, the first pieces sent down were the two opposite ones, *b* and *b'*, Figs. 3 and 4, which were to be hung from the set above, and support in turn the other two pieces, *c'* and *c'* by their halved ends. Pieces *b* and *b'* being in position, hanging loosely by the links and screw-bolts, pieces *c* and *c'* were put in place without special care as to exact position. The four corner-pieces ("studdles") came next, and then the nuts on the screw-bolts were sufficiently tightened to steady the whole. All the pieces were then carefully adjusted, wedges being put in between the timbers and the frozen wall, and tightened or loosened until the set was square in line. The nuts were then tightened finally, and the corner posts spiked.

The lagging was then sent down, sawed to proper lengths, and was put in place, commencing at the corner posts. The 1½-inch by 1½-inch strip, spiked on outside of each timber, served to support each piece of lagging temporarily, while heavy wooden wedges were driven in between it and the frozen wall. It was considered desirable to fill this space as fully as possible, and where the

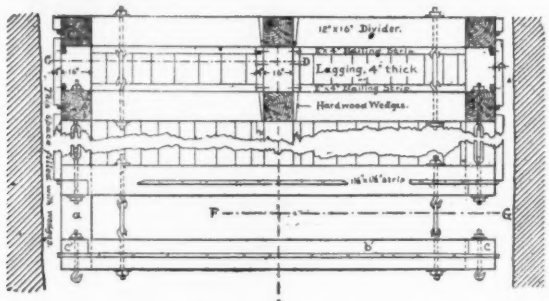
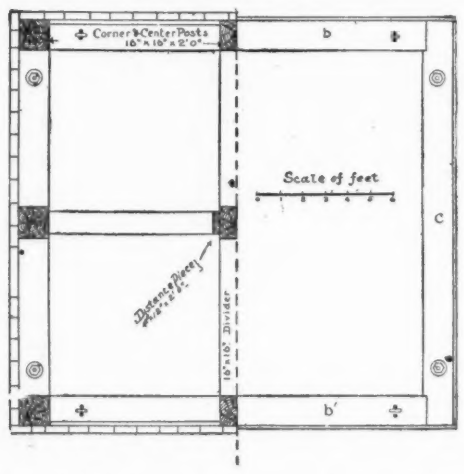


FIG. 3.—ELEVATION AND SECTION.



SECTIONAL PLAN ON LINE C. D. FIG. 4. PLAN ON LINE F. G.

LINING OF SHAFT.

material was especially fine hay was also packed in with the idea that it would, when wet, swell and fill the cracks between the 4-inch lagging pieces, and prevent any sand from entering. The only difficulty was to get the last piece in position, and careful fitting was necessary to have it go in tight.

When the lagging was completed, the wedges, driven in tightly all around, made everything solid and immovable. Subsequently, however, 2-inch by 4-inch pieces were spiked to the lagging and to the timbers, and the joints between the pieces of lagging were waterproofed by strips of tar paper dipped in hot pitch, and held in place by battens.

The details of the timbering are shown in Figs. 3 and 4. The timbering followed the excavation closely, chiefly to save the trouble of scaffolding. The last 15 feet of the shaft was close-timber from the bottom up, as will be more fully described hereafter.

The solid, rock-like walls of the excavation enabled the work of lining the shaft to by done with extreme precision, so that the finished shaft was nowhere more than a quarter of an inch out of truth or plumb, which is a degree of accuracy probably unattainable in sand shafts by any other method.

Making the Joint.—The completed excavation carried the shaft into the ledge from 4 to 10 feet. It was necessary to make a tight connection between the ledge and the lining, and to arrange for the support of the timbering from the ledge. This latter was accomplished in the usual manner by running short drifts into the ledge at the center of each side, and putting in extra long and heavy cross timbers. The joint was made by trenching in the bottom of the shaft for the bottom set of timbers, and carefully grouting the space between the timbers and the trench. To this bottom course of timbers the next course was fitted and spiked, and the space between it and the ledge filled with cement mortar. The gap between the lowest set of open timbers and the bottom of the shaft was in this way filled in with solid timbering. During this latter part of the work the only water coming into the shaft came directly from the ledge through small crevices, but under such pressure as to make it squirt up three or four feet into the air. There was not a trace of sand, and not sufficient water to keep a No. 6 Cameron pump going, the leak which had caused trouble previously having been completely frozen off.

When the timbering was completed, steam was turned into the shaft to thaw all ice on the timber, so as to permit the joints in the lining to be made tight with tarred paper, as before described. Finally, water was pumped in up to the level of the water in the soil, and the shaft left to thaw out. The purpose of filling the shaft with water was to equalize the pressure on the timbering during the thawing, which, it was thought, might bring sudden or unequal strains on the shaft.

At the completion of the work, in order to determine the extent of the freezing, a trial pit was sunk at the outer edge of the wall to a depth of 20 feet, and a steel rod was driven down considerably further. The wall had a batir, as before mentioned, but, assuming the measurement taken at the bottom of the pit to be an average value, the quantity of material frozen at that time was bounded by a cylindrical surface, 54 feet in diameter, and about 100 feet in depth. This mass of frozen material took a long time to melt, notwithstanding efforts of the mining company to hasten the result. It was not until July 25, or 50 days after shutting down ice machine, that the ice wall gave way sufficiently to permit water to come into shaft. The pressure of the sand on the shaft-lining did not disturb the alignment at all, and the shaft is now being carried down into the rock by the mining company, with ordinary methods.

Some additional details will be found in an article by the author in the *School of Mines Quarterly*, for April, 1890.—[Railroad Gazette.

THE "LANCASTER" SELF-PENETRATING GRAPPLES.

The "Lancaster" self-penetrating grapples are entirely free from drums, gears, chains, sheaves, catches and the like, such as necessarily are used in all other grapples and buckets. They obtain their powerful penetrating action by the unique, novel and simply-arranged compound levers peculiar to this important invention. These grapples are, preferably, made with four powerfully operated arms or scoops, which efficiently perform their various required services. In size and capacity they range from one-fourth cubic yard to four

or more cubic yards' capacity. They are made of best forged steel, and all pins and wearing parts are bushed for easy renewal, and every grapple is tested before being sent out. These grapples may be operated by the "Lancaster" hand or horse power, double drum hoisters, or by any makers' steam power hoisting engine using two chains. A complete outfit consisting of a "Lancaster" one jaw grapple and 20 H. P. hoisting engine has just been shipped to Messrs. Warthorst & Co., sand quarries, Massillon, O., for digging and raising earthwork at their quarries. For further particulars address the patentee and manufacturer, James H. Lancaster, No. 169 and 171 Broadway, New York.

Steel to the Front.

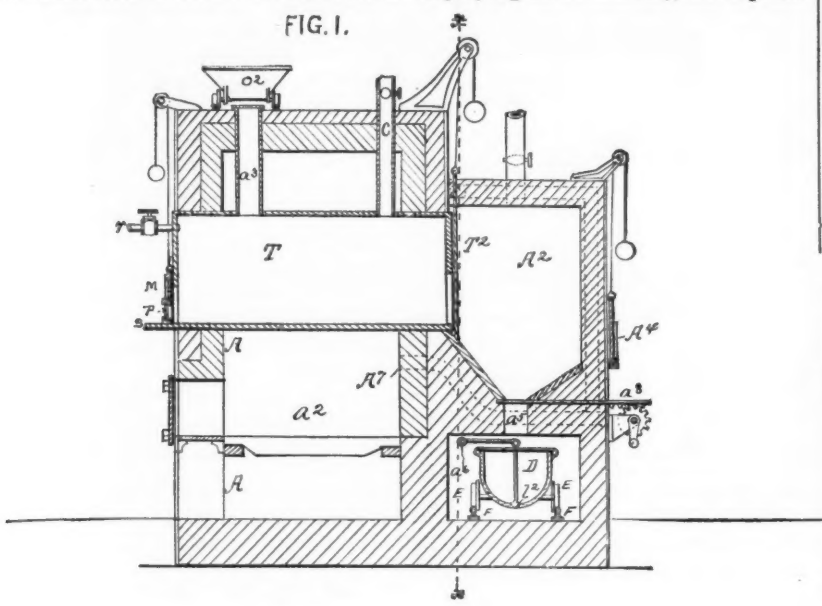
An interesting feature of the recently published statistical report of the American Iron & Steel Association is the increasing percentage of steel in the total production. About one-third of the bar "iron" now manufactured in the United States is steel, so is nearly half of the plate and sheet iron, and 40 per cent. of the cut nails and spikes. The rolled iron product, other than nails, only increased 7½ per cent. last year, while the rolled steel product, apart from rails, increased 32 per cent. It needs not to say that steel rails are now replacing those of iron on all the railroads which are efficiently managed. After that change is completed, what then? Will the next reform in order be wholsale substitution of aluminum for the ferric material, crowding that out of the way as the latter is displacing wood for many structural purposes? It is not improbable. Clay is much more plentiful than iron ore, and recent experiments at least indicate it as possible that the new metal will ere long be produced as cheaply per unit of volume, if not of weight, as its elder brother. Such a change would revolutionize not a few of our manufacturing processes, and perhaps some of the habits of the civilized human being.—[Metall-und-Eisen-Zeitung, Chicago.

IN the formation of a single locomotive steam engine there are nearly 6,000 pieces to be put together, and these require to be as accurately adjusted as the works of a watch.

THE CONLEY-LANCASTER PROCESS OF MAKING IRON AND STEEL DIRECT FROM THE ORE.

The latest development in the industrial world has been the successful production of iron and steel direct from the ore, by a process known as the Conley-Lancaster process, the patents for which are owned by the inventors, James H. Lancaster and Michael R. Conley, 169 and 171 Broadway, N. Y. The ambition of many metallurgists for a number of years has been to produce iron and steel direct from ore, without employing and incurring the expense of a blast furnace plant. It has long been realized that the benefit of such a process, if made a commercial success, would be a boon to the world and among the most important inventions of the present century.

FIG. 1.



The stumbling block to the success of most of the direct processes hitherto experimented with has been want of uniformity in the product. This was the difficulty experienced by Wilson, Harvey and others, owing to the unequal distribution of the heat and the difficulty of access to the ore in the furnaces or retorts to manipulate it, if necessary, and the lack of facilities for watching the operations to ascertain how the ore progressed, and when it was in a fit condition to be drawn.

The Conley-Lancaster process, illustrated herewith, has been found to overcome the difficulties previously experienced in other direct processes, and to be able to produce iron or steel of a uniform quality, and in unlimited quantities, from the lowest grade of magnetic iron and other ores, at a cost per ton of many dollars under the market price of iron or steel of similar quality produced by ordinary methods, while the cost of the plant for producing these results is more than 50 per cent. cheaper than a blast furnace plant, so a great saving is effected in the first cost of the plant and in the maintenance of it, as well as in fuel and labor, thus effecting a great saving in the cost of production of the metal, and from ores, too, of such low grade as to be unprofitable when treated by the blast furnace.

The plant and process consists in treating the iron ore in horizontal retorts constructed of metal, fire-clay, fire-brick or other suitable material, and formed at the front end with a small door opening, and at the rear end with a large opening, and supported within a furnace, provided at its rear with an auxiliary, or supplementary, heating chamber. It also consists in intermingling with the treated ore, hydro-carbon or other suitable gas, or with charcoal or coke, according to circumstances, for its purification.

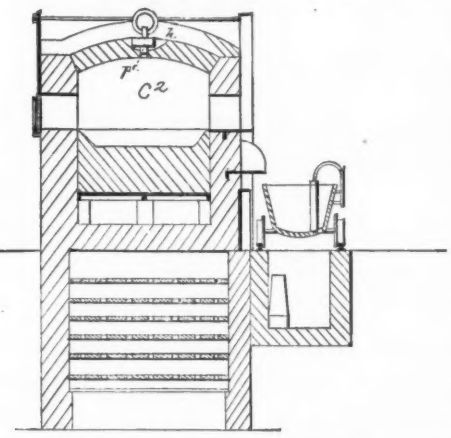
When the ore is ready for removal from the retorts, and which is ascertained by examination through peep holes, it is transferred or forced through the rear opening of the retorts, into the auxiliary heating chamber without its exposure to atmospheric air, which in itself is important, as it gives the ore no opportunity of taking up oxygen from the atmosphere after being treated in the retorts.

Fig. 1 is a longitudinal vertical section of a furnace. Fig. 2 is another longitudinal vertical section, embodying a modification. Fig. 3 is a vertical section on line *xx*, Fig. 1. Fig. 4 is a front view of the retort. Similar letters refer to similar parts throughout the several views.

Letter A represents the brick setting of the retort, with fire-brick lining. Supported within this brick setting is placed the retort T, made of metal or fire-clay, and of the shape shown in Fig. 3; a^2 is the fire-place or furnace, adapted to use coal, wood, coke or gaseous fuel, as circumstances may demand. The retorts are heated hereby to about 1,500 degrees Fahr. The retort, T, is partially open at the back end, and is provided with a sliding door or mouth-piece M, and at the front of which is constructed a small sliding door, P; *r* is a tube for admitting purifying gas into the retort, and C is a pipe for the discharge of impure gases from the retort, and a^3 is a chute for filling the retort with ore, which is provided with a lid or cover. These several communications complete the means of access in the interior of the retort. The mouth-piecce, M, is provided with a shelf-shaped lip, S.

To the rear of the brick setting, A, is constructed the auxiliary or supplementary heating chamber, A^2, with a fire-brick lining. The bottom of this chamber, A^2, is provided with outlets or openings, A^5, leading from the interior of the same to the vessel D, resting on truck E, moving on rails F, laid within the passageway A^6, formed under the said auxiliary chamber. The outlets, A^5, are opened or closed by the gate or plate, A^8, made of fire-clay, and operated by mechanism placed outside of the auxiliary chamber.

The opening in the back end of the retort leads into the interior of the auxiliary heating chamber, A^2 (see Figs. 1 and 2), and is opened or closed by the fire-clay gate or plate T^2, operated from the outside of the wall of the said chamber. The auxiliary chamber, A^2, is provided with a sliding door mouth-piece, A^4, and this opening is chiefly used when the grappling shovel is employed for removing the deoxidized ore or sponge to the open-hearth furnace, C^2, as shown in Fig. 2.

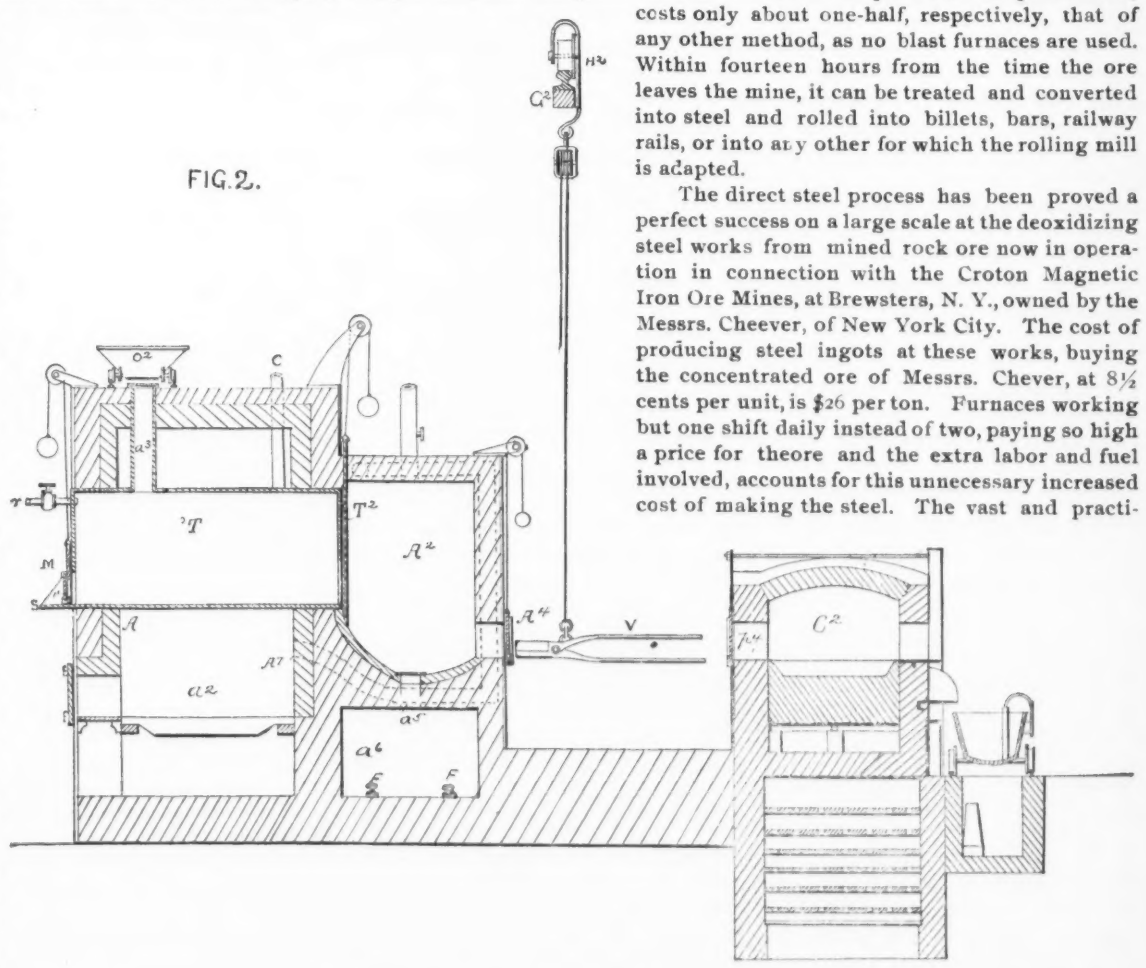


The auxiliary chamber, A^2, is heated from the furnace by the products of combustion passing therefrom and through flues A^7, running under and around said chamber and along the side and top and out of the chimney (not shown).

The new and important process and plant, duly secured by United States and foreign letters patents, succcessfully produce a fine and uniform quality of steel from all magnetic iron ores, fine, magnetic sea sand and also from all non-Bessemer ores high in phosphorus and sulphur that have hitherto been valueless. All rich hematite and specular iron ores can also be treated with equal success.

Steel rolled into 4-inch billets or down to 1½ to 2-inch bars, worth from $38 to $42 per ton on the open market, is produced from fine magnetic iron sea sand ore, for $18.05 per ton, and from mined rock magnetic iron ore for $21.05 per ton, and the plant and also the labor required for its production, costs only about one-half, respectively, that of any other method, as no blast furnaces are used. Within fourteen hours from the time the ore leaves the mine, it can be treated and converted into steel and rolled into billets, bars, railway rails, or into any other for which the rolling mill is adapted.

FIG. 2.



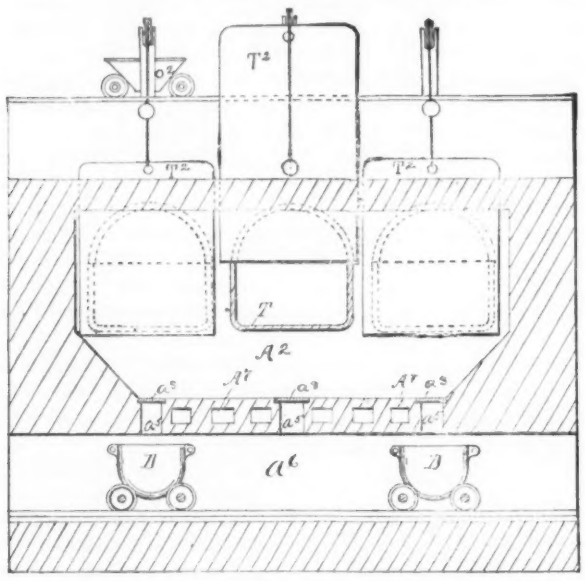
The direct steel process has been proved a perfect success on a large scale at the deoxidizing steel works from mined rock ore now in operation in connection with the Croton Magnetic Iron Ore Mines, at Brewsters, N. Y., owned by the Messrs. Cheever, of New York City. The cost of producing steel ingots at these works, buying the concentrated ore of Messrs. Chever, at 8½ cents per unit, is $26 per ton. Furnaces working but one shift daily instead of two, paying so high a price for theore and the extra labor and fuel involved, accounts for this unnecessary increased cost of making the steel. The vast and practically inexhaustible supplies of magnetic iron ores and magnetic sea sand, high in phosphorus and sulphur, in various sections of the world, hitherto of little value, are now available for making a high-grade steel, practically free from phosphorus and sulphur, and at a less cost than for which steel can be produced by the Bessemer process, using the only ores available to that system, and which are selected ores that have always a high market value.

The several operations that are necessary in the production of steel under all other known methods, are, by the Conley-Lancaster direct process, dis-

pensed with, and the consequent cost of labor and fuel as well as in repairs to the plant, is reduced fully 50 per cent., and a steel produced of high and uniform quality, such as is unattainable by either the Bessemer or by the other processes requiring blast furnaces. The magnetic iron ore, before being deoxidized and converted, is crushed and efficiently separated and cleansed by means of new and powerful magnetic ore separators in the dry state.

The following is an epitomized estimate of the cost of the complete Conley-Lancaster plant, and also of the working expenses for raising 1,000 tons

FIG. 3.



sea-sand ores, or from rock magnetic iron ores for producing 500 tons daily, of separated or cleansed magnetic oxide of iron 98 per cent. purity, and its conversion into 250 tons of finished steel reduced to 4-inch billets or 2-inch bars.

The cost of raising and handling 1,000 tons per day, of magnetic iron sea sand, or of mined magnetic rock ore, and which will yield 500 tons of separated or cleansed oxide of iron of 98 per cent. oxide of iron, and 250 tons of finished steel:

Cost per day for wages for raising and cleansing 1,000 tons sea-sand ore, etc	$ 250 00
Approximate cost per day for wages in mining 1,000 tons rock magnetic ore, and crushing and cleansing same	1,500 00
Or, say, 50 cents per ton for the cleansed or separated sea-sand ore, of 98 per cent. oxide of iron. Or $3 per ton for mined magnetic rock ore	
Freight of same from the mine or the separating and cleansing works to the furnace (per ton)	1 25
Total cost of separated and cleansed oxide of iron, 98 per cent. purity, delivered at the steel works from sea sand ore (per ton	1 75
Or, from mined magnetic rock ore (per ton	3 00

DETAILED COST OF PRODUCING STEEL UNDER THE "CONLEY-LANCASTER" DIRECT PROCESS, IN EITHER THE UNITED STATES OR CANADA.

Two tons of "separated" or cleansed magnetic sea-sand ore at $1.75	$ 3 50
(Such quantity being required for producing one ton steel). Or if mined rock ore is used, the cost will be $3 per ton, or $6 for each ton of steel produced.	
Cost of treatment of same in retorts, which requires 300 pounds of either charcoal or coke for each ton of ore, at cost of six cents per bushel of 20 pounds, viz.: 30 bushels at 6 cents per bushel	1 80
Labor on ore at retorts before going into the open-hearth furnace	1 00
Fuel for heating retorts being four tons of coal per day for each six benches, which would reduce about 100 tons of ore daily, and which would make the cost of ore treated 25 cents per ton; therefore for two tons of ore (such being required for producing one ton of steel)	50
Total cost of prepared ore ready for the open hearth furnace, which will produce one ton steel ingots	$ 6 80
Cost of labor and fuel for treament of same in the open hearth furnace for every ton of steel ingots produced	6 50
Allow for repairs of furnace per ton, say	50
	$ 13 80
Cost of ingots per ton at hammer or rolls—	
Rolling the steel into 4-inch billets, or 1½-inch or 2-inch bars would cost about and not exceeding	2 50
Interest on plant, salaries of chemist and superintendent, say, per ton	1 00
Allow for loss and any possible contingencies	25
Total cost of steel in 4-inch billets or bars if made from mined rock magnetic ore, per ton	$ 21 05

The selling cash price per ton in New York to-day of 4-inch billets is from $38 to over $42 per ton, according to quality, and which leaves a net profit of about $18 to $22 per ton.

COST OF COMPLETE ORE CLEANING AND STEEL PLANT.

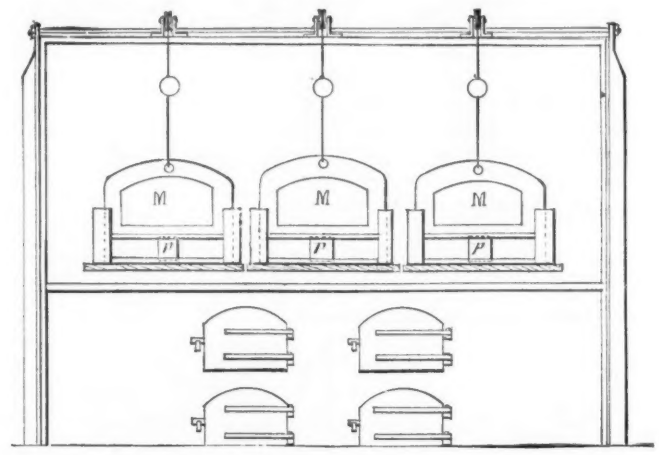
Total cost of a magnetic sea-sand ore separating or cleansing plant of 1,000 tons daily capacity, which will yield 500 tons cleansed ore, 98 per cent. oxide of iron, daily	$ 50,000
(Extra for crushers, rolls, power, etc., for working mined rock ore, $25,000.)	
Steel plant for producing 250 tons steel every 24 hours from either the 500 tons cleansed sea-sand, or from mined ore in six 25-ton open-hearth furnaces	225,000
The Conley-Lancaster deoxidizing plant, settings and all accessories	50,000
Rolling mill consisting of two 20-inch trains of rolls and heating forges for rolling 250 tons of steel daily into 4-inch billets or 1½ or 2-inch bars	100,000
Shears, hammer and tools	25,000
Total cost of the complete plants for making steel from sea-sand ore	$ 450,000
Or, a complete plant for working mined magnetic rock ore, $25,000 extra (as above stated), viz:	475,000

The above estimates may be taken as a fair and reliable basis for the erection of a complete ore-cleaning and steel plant and working of the latest improved "Conley-Lancaster" direct process on magnetic iron sea-sand or magnetic rock iron ore, in any part of the world. These specific estimates, however, relate to the vast accumulations of rich magnetic iron sea-sand ore on the sea coasts in California, Georgia and elsewhere, but they especially apply to the vast deposits on the shores of the Gulf of St. Lawrence, below Quebec, P. Q., and which are continuously being replenished by the action of the waves.

Although the entire cost of erection ready for starting the works is covered by an outlay of $450,000 and $475,000, respectively, an additional amount of, say, $150,000 for working capital to operate the same is needed. The entire amount of capital of the "Canadian Steel Works" (limited), for operating the "Conley-Lancaster" process and plant of this magnitude in Canada is, therefore, about $600,000 or $625,000, exclusive of the cost of the iron ore sea sand deposits, and also for the use of the "Conley-Lancaster" patent rights for working the entire output of these vast and never-failing magnetic iron sea sand accumulations.

After making all due allowances for renewals and repairs of furnaces, the yearly output, on the scale herein indicated, working 300 days, would not be less than 75,000 tons of 4-inch billets, which at the present market price of steel in the United States, would give a net profit on the year's output of about $1,200,000, or, at the lowest computation, $16 per ton net profit, on every ton of

FIG. 4.



steel produced. As is well known, such steel as is produced by the "Conley-Lancaster" process and plant for structural purposes, boiler and armor plates, ship-building, rails, and a thousand and one other uses, makes the demand for this steel practically unlimited.

13 PARK ROW, NEW YORK, Feb. 5th, 1890.

TO MR. JAMES H. LANCASTER, New York.

Dear Sirs:—We have been furnishing concentrated iron ore from our mines (the Croton Magnetic Iron Mines) at Brewsters, N. Y., to the steel works of the company operating the "Conley-Lancaster" Direct Steel Process. The steel made by this process being of good quality and produced without the use of any blast furnace, is certainly a new and important advancement in the production of steel.

Yours truly,
CROTON MAGNETIC IRON MINES.
By J. D. CHEEVER, Treasurer.

THE CROTON MAGNETIC IRON ORE MINES,
BREWSTERS, N. Y., Feb. 11th, 1890.

TO MESSRS. LANCASTER & CONLEY, 171 Broadway, N. Y.

Dear Sirs:—Replying to your inquiry respecting the working and merits of your Direct Steel Process and Plant, in operation in connection with the Croton Magnetic Iron Ore Mines, I beg to state that I have availed myself of the fullest opportunities of witnessing the development of the process and plant during the whole time, from commencing its erection until now.

The results certainly are most satisfactory, insomuch as steel of excellent quality has been made during the entire time the works have been in operation. The numerous tests that I have made from large heats from time to time have proved that the steel is of an excellent and uniform grade, and also that the success of the "Conley-Lancaster" Direct Process is beyond any possible doubt.

The fact of making steel in so simple a manner, without involving the expenses attending the erection and operation of expensive plants, brings this system into such prominence that it cannot fail to be readily appreciated by all engaged in this important industry. The more your process is investigated, the more assuredly does its value become apparent.

Wishing you success in the speedy and general introduction of your important system, I am, dear sirs,

Yours respectfully,
W. H. HOFFMAN,
Consulting Engineer and Manager, Croton Magnetic Iron Ore Mines, Brewsters, N. Y.

NEW YORK, February 11th, 1890.

TO MESSRS. LANCASTER & CONLEY, 171 Broadway, N. Y.

Dear Sirs:—Replying to your inquiries as to my knowledge and opinion of the "Conley-Lancaster" Direct Steel Process, the special plant required for the production of the steel, and also of the steel produced by that process, I beg to state that after a most careful investigation of the system and plant at Brewsters, N. Y., for making the steel, and the actual tests and working of the steel at my mills at Boonton and Powersville, N. J., I am able to unreservedly assert that your method, and also the plant used for producing the steel, as well as the steel itself, embraces a most novel, complete and perfect system.

During my forty years of experience in the manufacture and working of iron and steel, I have never worked iron and steel of a more uniform and better quality. The various lots of steel billets made under the "Conley-Lancaster" process at Brewsters, and hammered and rolled at my mills, equaled in working the first quality of Swedish iron.

In my opinion the "Conley-Lancaster" patented process and plant is the only successful system for making steel direct from the ore without using a blast furnace, and as I have been financially interested in the development of the Wilson and other (now obsolete) direct processes, my opportunities for thoroughly and practically familiarizing myself with the difficulties and methods involved have been very considerable.

No blooms made from pig iron in any blast furnace could work better or be of a more uniform quality than the billets made direct from the ore by your process and hammered and rolled at our mill.

The economy of the "Conley-Lancaster" system must soon insure its general adoption throughout the world, and also the discarding of all blast furnaces.

Idle and unprofitable iron works and mines can, by your process and plant, be worked at a large profit, and the steel produced by this new method has an unlimited market for structural purposes, boiler and armor plates, ship building, rails and a thousand other uses where a good, soft and reliable quality of steel is indispensable.

Wishing you and Mr. Conley continued success in your vast enterprise, I am, dear sirs,

Yours faithfully,
ALEXANDER ELLIOTT.

JERSEY CITY STEEL WORKS,
JERSEY CITY, N. J., April 9th, 1890.

TO MESSRS. J. H. LANCASTER & M. R. CONLEY, New York.

Dear Sirs:—We have hammered, rolled and tested steel ingots at this mill, made by your Direct Process, and beg to state that the finished steel therefrom was all of uniform and excellent quality.

Steel ingots such as those, and produced at the cost of yours, cannot fail to revolutionize the entire steel-making industry. I am, dear sirs,

Yours faithfully,
JOEL DICKENSON, Supt. and Gen'l Manager.

For converting and working any existing iron works or mines or starting of new works, special arrangements will be made on receiving particulars of the properties or works.

For detailed cost of producing steel and for all necessary plant therefore, in any part of the world, and all further information respecting the United States and foreign patents, licenses, reports, etc., address James H. Lancaster, consulting engineer, etc., 169 and 171 Broadway, New York, U. S. A.

THE German *Handels-museum* in calculating the world's consumption of coal reckons that the steam engines of the world come to 10,000,000 horse-power; that these use about 12,000 tons of coal per hour on the average; that gas lighting consumes 10,000 an hour; gas engines, 4,500; iron smelting, 5,000, and other metals 4,000 tons an hour; other factories, 5,000 tons, and domestic heating, 10,000 tons an hour; all which comes to over 50,000 tons an hour. On the other hand, the whole output is 550,000,000 to 600,000,000 tons per annum, or about 65,000 tons per hour.

AMONG THE IRON MINES.

Lake Superior Mining Notes:—

VERMILION RANGE.

At the Minnesota Iron Co.'s great mine, about 1,500 men are at work, and 2,000 tons are taken out daily. It is expected that the shipments from this mine this year will reach nearly 500,000 tons. More ore is opened up than ever before in this mine, and there will be no trouble in reaching this figure. —[Iron Journal, Tower.

Camp & James are doing some work on section 36 63-12, southwest of Ely, and have discovered some good ore and many excellent indications. They do not know yet whether they are in a float or a solid ledge, but there is every indication that a good mine will be developed.—[Iron Journal, Tower.

MESSABIE RANGE.

On the Messabie range considerable prospecting and exploring is being done. At the Mallman mine men are working, and there is a fair prospect of a good paying mine, in fact, clean ore of excellent quality is now on the dumps to the extent of several thousand tons. The Stone Iron Co. is doing some work near the railroad track. About ten men are busy exploring, and it is expected that a good mine will be opened in this neighborhood, but it is not likely that very much ore will or can be taken out this season, as the development work is not far enough along yet to permit it. This company has an excellent grade of ore.—[Iron Journal, Tower.

MARQUETTE RANGE.

At the Lakeside the drill penetrated a body of first-class ore at about 160 feet from surface and from 30 to 40 feet of it has been passed with the bit still in ore. This is regarded with special interest as furnishing a link in the Cambria, Negaunee, Queen and Milwaukee chain of mines, which, it is contended by many mining experts, will sooner or later be made complete by the development of mines on every forty in the circuit, as indicated, even extending to the Lake Angeline on the west, and being distinct from the inner range, upon which is the Lake Superior, Cleveland, Jackson, New York.—[Iron Herald

The Escanaba River & Iron Co. have commenced active mining operations on the Cheshire property recently purchased, and find the old workings to be in much better condition than was expected. A small force of men is employed at present in cleaning up and arranging for placing the new plant of machinery already purchased and upon the ground, as we believe. The ore is first-class in quality, and from present appearances there is an abundance of it. The company own between 700 and 800 acres of land, nearly all of which is mineral territory.—[Iron Herald.

The latest and most important find on the Marquette Range is the penetration of 34 feet of fine ore by the diamond drill on the U. S. Grant property, which is located on the Negaunee East Range, but a short distance from the Negaunee mine. The drill has been for some time working in ore, but the formation was a mixed one and it was not until last week that it got into the clean ore. The management of the property has passed into the hands of William F. Anderson, of Negaunee, who was up to the time of the sale of the mine to the Schlesinger syndicate in charge of the South Buffalo Mine.—[Lake Superior Mining and Manufacturing Review.

GOGEBIC RANGE.

A new boiler and machinery has just been purchased for the Ruthrauff, at Upson. They will put in a larger pump to keep clear of water. The work has been closed down on account of the water. They expect to reach ore in about ten days after they are started. John G. Parke, a partner of James E. York, visited and looked over the property. He was well pleased with the lookout, and gave instructions to rush matters as rapidly as possible.—[Interstate News-Record.

James Corrigan, of Cleveland, the big man of the Eureka (late Danglers) mine, at Black River, was at the mine Wednesday, in conference with Capt. Whitesides, the manager of the mine. Corrigan is red-hot on the subject of the contest over the Gogebic forty, and says he will "law it" till Gabe blows his last trump before he will let go.—[Interstate News-Record.

Mining operations at the Iron Belt are decidedly lively, and Superintendent McVichie intends to make a decidedly creditable shipping record. The new level just being opened up is showing well in ore, and everything connected with the property is moving along prosperously and smoothly.—[Iron Tribune.

A contract has just been let by the Pittsburgh Mining Co. to sink their shaft to a depth of 300 feet. It is expected that the Comet vein will be encountered at this depth.—[Lake Superior Mining & Manufacturing Review.

The Black River, or South Valley, covering the northern half of the s. w. ¼ of sec. 16 (adjoining the Valley on the south), under option to the Metropolitan people, is making an excellent showing at the point where the present work is being done—near the northwest corner of the property. A pit is down between 70 and 80 feet, and the material raised shows a large percentage of iron, though still too lean to be merchantable.—[Pick and Axe.

MENOMINEE RANGE.

The Dunn & Co. exploration, east of the Armenia mine, is looking better every day. They are now working in a very fair grade of ore, and the indications are that it is in place.—[Diamond Drill.

The *Range* says the character of the vein exposed thus far in the Chapin pit, at the west end of the mine, is a little disappointing. It is considerably mixed with jasper, and in this respect differs from the vein further east. In the old portions of the mine, the vein has been found to be clean ore wherever stripped, and it was hoped the same would prove true in this instance. Probably the ore will improve deeper down, and very likely in other portions of the pit where it is yet uncovered.

The Scofield continues to improve, and is reasonably certain of blossoming into a full bloom mine within a few months. Nearly one-half of the shaft is now in ore, with an excellent prospect of its being entirely bottomed in iron as the sinking progresses. The shaft is going down in the foot-wall, which guarantees its permanency. Supt. Polderman intends to sink 105 feet, and at a depth of 100 feet cross-cut southeast across and drift lengthwise of the vein, which, as demonstrated by a system of test-pits, is at least 700 feet in length. Milwaukee capitalists are negotiating for a large interest in this exceedingly promising property.—[Mining News.

The Fisk mine, or the Proctor Mining Co.'s property, on section 33, 48 18, near the Commonwealth mine, is looking better and better every day, and continues to attract great attention, both here and elsewhere. The shaft now down 23 feet, is bottomed in thoroughly clean, high-grade ore, and all indications point to a big body of it upon the property. Superintendent Fisk intends to carry the shaft down to a much greater depth, and then drift and cross-cut. This week's developments at the Fisk have excited mining men to the highest pitch, and now even the most skeptical recognize the Fisk as a mine. The property was formerly known as the Noyes-Hallett exploration.—[Mining News.

Lake Superior Shipments of Iron Ore:—

Lake shipments of iron ore from the mines of Lake Superior, for the season of 1890, up to Wednesday, May 28th, are as shown by the appended statement, condensed from the Marquette *Mining Journal:*

MARQUETTE RANGE.

American	166	Imperial	2,358	Prince of Wales	1,338
Barnum	2,818	Jackson	18,058	Prout	1,223
Buffalo	15,889	Lake Superior	55,067	Queen	14,870
Cambria	16,732	Lillie	7,091	Republic	47,674
Champion	35,511	Lucy	8,860	Salisbury	13,2 6
Cleveland	39,446	Milwaukee	5,533	South Buffalo	12,189
Cliffs Shaft	25,941	Michigamme	12,114	Volunteer	19,095
Detroit	586	Negaunee	11,878	Winthrop	24,532
East New York	8,645	New York	1,944		
Humboldt	2,814	Pitts. & L. Angeline	48,499		
Total, Marquette Range					447,608

MENOMINEE RANGE.

Aragon	1,416	Great Western	13,992	Norway	12,373
Armenia	6,111	Half and Half	383	Paint River	7,042
Chapin	118,865	Hamilton	4,026	Perkins	1,406
Commonwealth	18,479	Iron River	21,972	Pewabic	3,623
Cyclops	13,404	Ludington	15,877	Shafer	6,798
Dunn	22,208	Mastodon	13,944	Vulcan	26,081
Florence	27,710	Millie	7,048	Youngstown	5,020
Total, Menominee Range					347,668

GOGEBIC RANGE.

Albany	4,264	Father Hennepin	2,576	Palms	6,477
Anvil	7,577	Germania	8,306	Pewabic	313
Ashland	74,493	Iron Belt	14,102	Section 33	14,128
Aurora	40,228	Montreal	5,265	Superior	2,195
Brotherton	6,720	Mt. Hope	13,914	Trezona	6,517
Cary	10,902	Norrie	150,539	Windsor	5,266
Colby	43,003	Pabst	18 326		
Total, Gogebic Range					435,141

VERMILION RANGE.

Minnesota Iron Co	85,026	Chandler	36,763
Total, Vermilion Range			121,789
Grand Totals			1,351,606
To corresponding date of 1889			1,170,858

It may be stated that for the season of 1890 up to June 1st very nearly one and a half million tons of ore have gone forward by lake as compared with about 1,200,000 tons for the same period in 1889. Last week the Marquette and Gogebic ranges were less than 1,000 tons apart, but now there is over 10,000 tons difference. That it may be seen where the gain over last year's shipments, which to date was 184,689 tons is coming in, the production of the several ranges at the corresponding date last year is given and may be compared with the figures in the table of shipments: Marquette range, 441,878; Menominee, 332,546; Gogebic, 282,169; Vermilion, 110.324. It will be noticed that the figures for the Marquette and Menominee range product in the two years is almost exactly the same, that there is very little change in the Vermilion figures, and that the Gogebic range in itself furnishes the increase.

The Manufacture of Metallic Seamless Tubes

Randolph & Clowes, Waterbury, Conn, write the Chicago *Journal of Commerce:* "Permit us to criticise a statement which appears on page 7 of your issue of May 14th in an article from the Boston *Herald*, headed, 'Molten Steel and Brass Rolled into Seamless Tubes,' in which it is stated that one concern made and sold $13,000,000 worth of tubes at a profit of $1,250,000 last year. As far as the production of seamless brass and copper tubing in the United States is concerned, we are in a position to know that this statement is so far from being in accordance with fact, that its correction may be a matter of interest to you, as well as to your readers. As manufacturers of this tubing, we know very nearly the volume and extent of the business in this country, and can say positively that the entire output for the year 1889 did not exceed, or probably reach, 700,000 pounds per month, or, say, 8,400,000 pounds in all. The price at which ordinary seamless drawn brass tubing of iron pipe size was sold in 1888 was about 19 cents per pound, net. To give the writer of the article every advantage, we assume it to have been 25 cents. Under these circumstances, the total money value of the output of the country for 1889 did not exceed $2,100,000, which is less than double the amount of the profits claimed to have been made."

A Big Natural Gas Pipe Line.

The Pittsburgh *Commercial Gazette* says that a natural gas line, 20 miles long, and costing in the neighborhood of half a million dollars, is to be built at once from the wells of the Carnegie Co., in Washington county, Pa., to the steel works of Carnegie, Phipps & Co., at Homestead. Mention was made in the columns of the *Gazette* a few days ago of the purchase by the Carnegie firm of 10,000 acres of gas lands in the county named. Some of the best gas land in that section were included in the sale, and it is to this field that the line mentioned above will be built. The placing of this contract, as well as the other large one made by the Philadelphia Co. for its new line to the Bellevernon field a few days ago, indicates a big revival of the pipe-laying industry this year.

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INDUSTRIAL SUMMARY.

New Enterprises:—

The Peru Mower Co. has been incorporated, to operate at Peru, Ind. The capital stock is $50,000, in shares of $50 each.

The Burnheimer Wire Co., of Minneapolis, Minn., with a capital stock of $20,000, has filed articles of incorporation with the Secretary of State.

The Pioneer Iron Works have been incorporated at Middlesborough, Ky., by William Arthur, J. W. Forest and S. W. Ritchie, to erect foundry and machine shops.

Younkin, Watkins & Co. have started a foundry for general work, at Williamsport, Pa. Mr. Evans, formerly of Leman, Evans & Co., is connected with the enterprise.

The American Fire-Proof Steel Car Co., with $1,500,000 capital, will locate a plant at Bridgeport, Ala., having a monthly capacity of 235 steel-clad freight cars, and 25 passenger cars.

B. I. Walshe and Timothy Maroney, of New Orleans, La., have incorporated the Attalla Iron Co. to build an iron furnace at Attalla, Ala.; also, it is stated, a rolling mill. The capital stock is $400,000.

The Norton & Jones Machine Tool Works, Plainville, Conn., have succeeded W. P. Norton, of Bristol. The firm build single and multiple-spindle sensitive drills as a specialty, and other fine machine tools.

Articles of incorporation have been filed for the Gadsden (Ala.) Bar & Steel Mill Co.; capital, $150,000. The mill will comprise one 100-ton bar mill and four sheet iron mills. When completed the mill will work 300 hands.

The Baltimore Ventilating & Motor Co. has been incorporated at Baltimore, Md., by L. H. Durling, C. A. Vaile, L. F. Young and others, to manufacture and sell ventilating fans, blowers and motors. The capital stock is $50,000.

The Empire Manufacturing Co. has filed articles of incorporation with the recorder, at Keokuk, Ia.; capital stock $75,000, and the businesss is to be the manufacture of agricultural implements and machinery. The incorporators are J. J. A. Zeller, L. E. Phelps, R. K. Swift and others.

The Thermal Electric Co., Kittery, Me., has been incorporated with a capital stock of $125,000. It will manufacture various electrical devices, especially thermal devices and thermal cut-outs. Incorporators: Lorenzo B. Favor, Edward O. Gaffney and John Renby, Jr., all of Gloucester, Mass.

The officers of the R. W. Coffee Stemming Machine Co., recently formed at Bedford City, Va., are J F. Slaughter, Lynchburg, president; S. A. Berry, vice-president; M. P. Burks, secretary and treasurer, to manufacture the R. W. Coffee stemming machine. The capital stock is to be $1,000,000.

From Norwalk and Toledo, O., two plants being consolidated, will come the Muskegon (Mich.) Machine & Foundry Co., to engage in the manufacture of sewing machines and various kinds of light machines. A leading feature will be the manufacture of sewing machines, and an electric motor to furnish power for these.

Articles of incorporation have been filed in the office of the Kansas Secretary of State by the National Car Heating Co. This corporation, whose headquarters will be in Topeka, has a paid-up capital stock of $100,000, and is officered as follows: President, N. R. Baker; secretary, I. N. Baker; treasurer, H. W. Sharp. The letters patent under which the corporation will operate were issued to J. Q C. Searle, for the Searle steam heating and double circulation of hot water, an invention that can be utilized for houses as well as cars.

Minnesota capitalists have organized the American Foundry Co., with a capital of $100,000, to operate a foundry at Tacoma. The officers are C. N. Parker, president; H. W. Topping, vice president; C. S. Milliken, secretary and treasurer. Mr. Parker and Mr. Topping are the lessees of the Northern Pacific railroad foundry at Brainerd, Minn., where they have the contract for manufacturing all the iron and brass castings used on the railroad from Helena east, and on the branch lines. The company has closed a contract with the Northern Pacific railroad for all its iron and brass castings, for the next five years, from Helena west, including all branch lines.

Recent Illinois incorporations: Chicago Refined Metal Co., Chicago; to manufacture and sell metals; capital, $200,000; incorporators, H. P. Benton, J. S. Ward, Gordon McDowell.—Chicago Heat Storage Co.; to manufacture appliances for producing storage heat; capital, $60,000; incorporators, C. G. Singer, F. W. Melick and John Le Boutiller.—O. H. Jewell Filter Co., Chicago; to manufacture water filters; capital, $8,000; incorporators, C. H. Black, E. S. Chambers and W. F. Peters.—Worrell Electric Construction Co., Chicago; to construct and maintain electric plants; capital, $500,000; incorporators, C. E. Gaylord, M. J. Frost and C. V. White.—The Pettinger & Davis Mining & Manufacturing Co., Centralia; to mine and manufacture; capital $30,000; incorporators, G. L. Pettinger, C. G. Davis and others.—Idaho Gold Mining & Milling Co., East St. Louis; to do a mining business; capital, $3,000,000; incorporators, J. Jarrett, Tom Miller, Sr., and others.—Calorific Stove Co., Chicago; to manufacture calorific and other stoves; capital, $100,000; incorporators, G. Meyers, F. D. Holbrook and F. W. Holbrook.—Wonder Sewing Machine Manufacturing Co., Chicago; to manufacture sewing machines; capital $500,000; incorporators, H. M. Pettingill, Josiah Cratty, W. W. Watson.—Hinson Drawbar Attachment Co., Chicago; to manufacture railway car supplies; capital $250,000: incorporators, J. A. Hinson, F. A. Small and J. F. Hahn.

Enlargements, Additions, Removals, Etc.:—

It is reported that the Valley Iron Works, Williamsport, Pa., will remove to Lynchburgh, Va.

The Phenix Iron Works, Meadville, Pa., will increase and otherwise improve their plant.

The Chantrall Tool Co., of Reading, Pa., contemplates erecting large hardware works at Pottstown, Pa.

The Porter Foundry & Machine Co., Limited, Pittsburgh, Pa., is building a 50x50-foot addition to its foundry, and will soon make further additions, all of which will be fitted out with modern improvements and operated by steam power.

Preparations have been begun by Messrs. Daniell & Kidder, at Franklin Falls, N. H., for moving the machine shop and erecting an addition on the north side of the Winnipiseogee river. They will consolidate the Cate, Ryan & Co. shop with the Haynes & Kidder shop, and have one well equipped for their business.—[American Machinist.

Amendatory articles of incorporation have been filed by which the authorized capital of the McCosh Iron & Steel Co., of Burlington, Ia., is increased from the present limit of $200,000 to $500,000. This large addition to its stock is rendered necessary by the extensive additions now being made by the company. The company now employs close to 300 hands. The additions being made will nearly double this amount.

General Industrial Notes:—

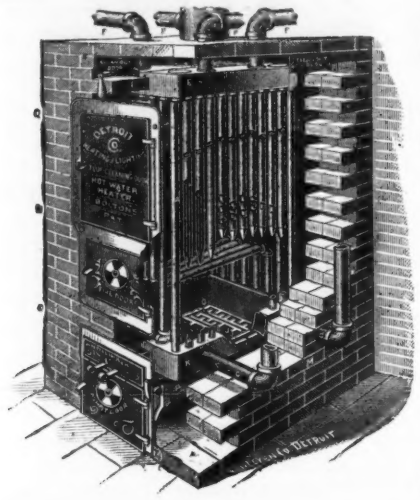
The Lodge & Davis Machine Tool Co., of Cincinnati, O., report that business is very brisk. They have just made shipment of a carload of tools to Anniston, Ala., one to Boston, Mass, and a carload to each of their New York and Chicago houses, through which they are doing an enormous business.

The Avery Stamping Co., of Cleveland, O., have recently completed the heaviest drawn cylinder heads, they think, that have ever been made in this country. They are $\frac{9}{16}$″ in thickness, 18″ in diameter inside by 3″ flange, made from a very fine quality of steel, and having a tensile strength of 70,000 pounds to the square inch. Parties wishing heavy work of this character would do well to correspond with them.

One of the most difficult castings ever made was lately turned out at the Dickson Manufacturing Co, at Scranton. It was a high-pressure steam cylinder, for the steamer "City of Alexandria," in South American waters. It took four weeks to prepare the casting; the first attempt was successful, and a perfect cast was made. The bore of the cylinder is 42½ inches; the casting is 7½ feet high. The cylinder itself is forced into a jacket, which also forms the steam-chest and part of the receiver. The total weight is 26,750 pounds.—[American Manufacturer.

The Eclipse Pump Manufacturing Co., Cincinnati, O, write us that they have orders on their books now for about 50 steam pumps, of all sizes, for all parts of the country. They have a large trade in Europe They have shipped several large pumps to coal mines near Evansville, Ind., and are fitting up a large brewery, at Nashville, Tenn., with all the steam pumps required; also, have orders for pumps for irrigating orange groves in South Carolina. Business is very good and increasing right along. Their direct acting steam pump received the highest award at the late Centennial Exposition, held at Cincinnati, O., and they are having a very large trade in this style of pump. Parties desiring to purchase pumping machinery for any purpose, should not fail to write them for prices and catalogue.

BOLTON



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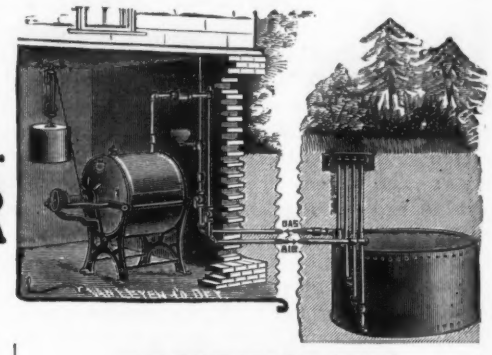

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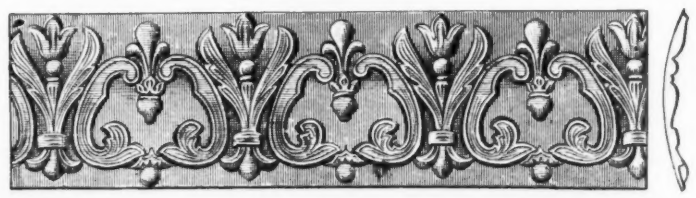

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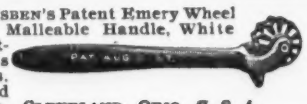

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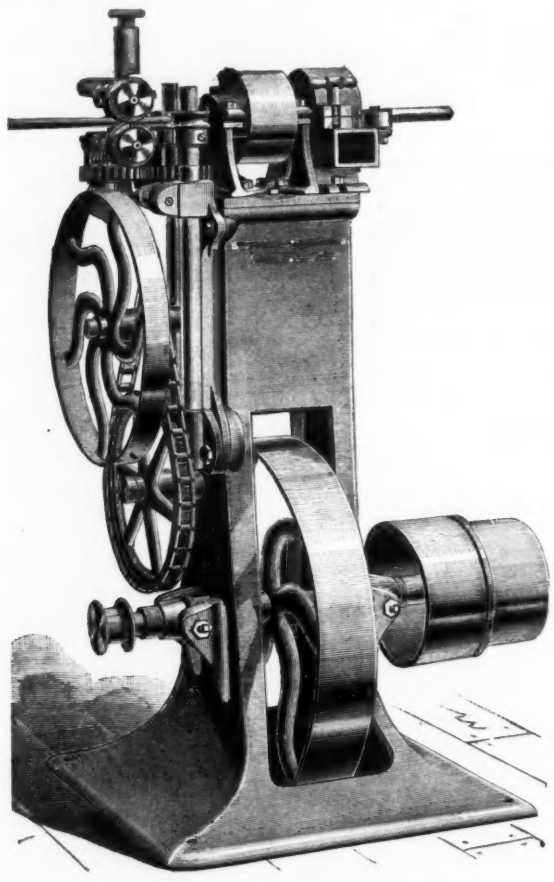
IMPROVED DOWELL MACHINE.

The engraving herewith represents an improved patented dowell machine, manufactured by G. H. Scanlan & Co., 93 Preble street, Portland, Me. It is especially adapted for fine and rapid work. The stock to be operated on is first sawed into square sticks, and then placed to the infeeding rolls, where it is acted on by the cutter-head, on which the following are valuable improvements: The knives are placed in rolling posts fastened to the side of the machine, and can be changed very rapidly. The knives rest on a set screw, which, by raising or lowering, will cut a smaller or larger chip, which is very advantageous, the knives always acting on the center of the stick, being turned, thus doing very smooth work, and not getting dull nearly as often as in the old way. Another and highly important improvement is the arrangement for turning different sized rods, which in other make machines have to have a cutter-head for each size rod to be turned, thus making the heads to cost more than the machines. This machine will turn any size rod by simply putting in a small sleeve the size of the rod to be turned, which will not cost one-twentieth part of the cost of the cheapest cutter-head made, the change in size



being made in less time than one head could be taken off and another put on. The out-feeding rolls are geared or not, as purchasers desire. They are four in number, as will be seen by the cut, two placed horizontally and two vertically, thus securely holding rods on all sides and keeping them perfectly round, and by this method less pressure on the stick is rquired to keep it from turning with the center-head. The machine is built very stiff and substantial, and is highly finished. The cutter-head and all revolving parts are highly balanced, and can be run at a high rate of speed, and will turn from 3,000 to 4,000 lineal feet of good, smooth work per hour. This machine, for turning curtain rolls, rods, broom handles, dowells, chair stock and all kinds of round work, has improvements which make it the superior of any machine on the market. Another great improvement of this machine is the way the knives are arranged in the cutter-head, being three knives with very large cutting surface; the knives are placed in rotation, and by their peculiar manner of adjustment can be arranged so each knife will do its proportionate share of the cutting, a point which had never been attained before. The manufacturers will be pleased to give further information.

"ENGLISH AS SHE IS SPOKE."

Englishmen are often twitted with their ignorance of foreign languages the superior linguistic accomplishments of the German being held up for admiration. Here is a specimen from a circular just to hand:—"Most valuable patent to be sold at a very low rate. Only solid manufactories. By means of a painful labor of many years I succeeded to supply to the cement, clay, and lime industry an engine as never a similar existed and which serves to mass-fabrication of adobies as well as of baken bricks. * * * My engine produces in the shortest time wellformed strong stones of cement slacks and black lime mixtion, argil, clay and fire-proof earth, which directly from the engine may be laid down in beds of 15-20 stones thoroughly air-proof, without suffering any damage. By this the painful singular piling up on frames and setting otherwise is to be spared. Beyond the engine cleans spontaneously its frames, whereby obstructions usual in other engines and long interruptions never occur. The solid quality of my engine needs rare repairs. * * * I fabricate two or three beating engines which are to be drawn according to the materials resp. the mixtion of them to be manufactured." The advertiser winds up by saying, "I am quitely ready for any more informations." The machines are supplied "post paid the Waggon from the Station Allbruck," with "particular accordance for export." The testimonials are highly amusing, one grateful customer saying, "This engine managing within my new cementfactory works to my full contentment. * * * I impart the best praise to Mr. ——, because he constructed also the mechanical works in whole the factory to my contentment." Another says, "We may only express you our best compliments for your press furnished to us." A third delivers himself as follows, in what reads like a tone of complaint, but which is really the opposite;—"It strikes me that the stones don't show a laminated structure, as is usual in stones, which are pressed dry." Yet another says:—"We don't doubt, your engine will have a great future. As soon as we shall enlarge our manufactory, we shall commit an other one." This is especially funny:—"We answer readingly in tally to your letter of 8th February and attest you, that we have two of your engines in management. They serve to rawpowderstones for the kiln and we are much satisfied with their work." We rise from a careful perusal of the cireular with the consciousness that we do not quite understand what the advertiser is driving at, but we have added it to our collection of examples of English *pour rire*.—[Engineer.

COKE BRICKS FOR FURNACE LININGS.

At the January meeting, in Dusseldorf, of the Society of German Iron Manufacturers, F. Burgess, of Gelsenkirchen, spoke as follows on the subject of furnace linings:

It is well known to those who have to do with blast furnaces that the hearth and bottom of a furnace are the parts which, so far, have been least successful in performing the duty expected of them.

Often, after a short time, only a few inches remain of a hearth that was three or four feet thick when set in. Then streams of water must be played on to keep the hearth in any condition at all. The great inconveniences of this state of things need no emphasizing. The cause of this quick destruction of the refractory material lies clearly in the circumstance that the hot slag, which in most processes is now acid and now basic, dissolves the lining in the shortest time and carries it away as slag. An experiment will show that the best refractory stone of the most widely differing composition, when placed in a stream of slag, will be completely melted away in one to two hours. This fact determined me to look for a better material. Carbon suggested itself to me, because it is apparent in the blown-out furnaces that the best inner coating consists of small coke and graphite cemented with lime and slag, and in this case it is the carbon which has proved the refractory armor. In practice, also, it is well known that slag runs best in a bed of coal or coke ash. The first experiment, which I made in 1882, was to make a combination of coal, coke dust, graphite, etc., with clay, and to use it in the form of bricks. The firm of Dr. Otto & Co. furnished me with several samples of this brick, which were somewhat defective, as in the process of making the bricks, the carbon had been partially burned out; but even these gave good results.

It was not possible to patent this process in the metallurgy of Brundkerl. It is mentioned that the lead furnaces in the Harz region were lined with such a mixture of coke, dust and clay. In 1885 there appeared a paper by A. Purcel, on ferro-manganese, in which it was stated that already for several years in La Voult and Taimain, France, hearth and bottoms of graphite bricks had been used. The raw material was retort graphite of one to two per cent. ash, which, ground and burnt with tar, was then made into bricks and calcined. Part of the tar was caked, and burned the graphite into a hard and durable brick. I made experiments with ground coke poor in ash, instead of graphite, and these experiments always gave good results. In 1885 we lined our furnace No. 2 with this material. And the use of it, even with large production, has given satisfaction ever since. The cost of the bricks is about 100 marks per ton.

What the World Owes to Workingmen.

Said Sir John Lubbock recently in a lecture to English workmen: "It is remarkable how many of the improvements to which we owe the marvelous development of our manufacturing industry have been due to workingmen. Watt was a mechanical engineer; Henry Cort, whose improvements in manufacturers were said to have added more to the wealth of England than the whole value of the national debt, was the son of a brickmaker; Huntsman, the inventor of cast steel, was a poor watchmaker; Crompton was a weaver; Wedgwood was a potter, Brindley, Telford, Mashat and Neilson were workingmen; George Stephenson began life as a cowboy at twopence a day, and could not read till he was eighteen; Dalton was the son of a poor weaver; Faraday of a blacksmith; Newcomen of a blacksmith; Arkwright began life as a barber; Sir H. Davy was an apothecary's apprentice; and Boulton, the 'father of Birmingham,' was a button maker. To these men, and others like them, the world owes a deep debt of gratitude. We ought to be as proud of them as of any of our generals or statesmen."

INDIA has both iron ore and coal, but they are so far apart that iron cannot at present be made profitably. Meanwhile the uses of iron in that country are increasing rapidly, the Glasgow *Engineer* now states that it is proposed to import iron in the "pig" state, and to instruct natives in its manipulation. —[Iron Trade Review.

The South can make iron more cheaply that it can be produced anywhere else in the world. The continued increase in the world's consumption of iron means a continued expansion of the iron trade of the South.—[Manufacturers' Record.

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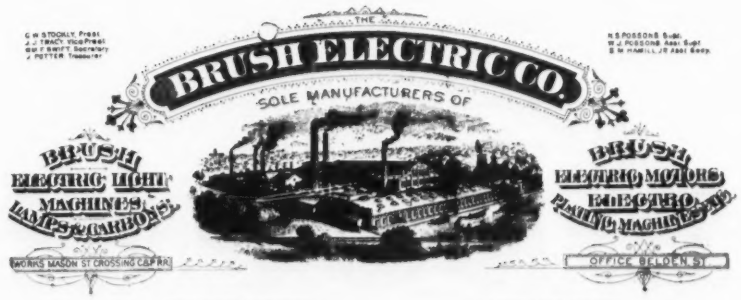
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By [signature] Treasurer

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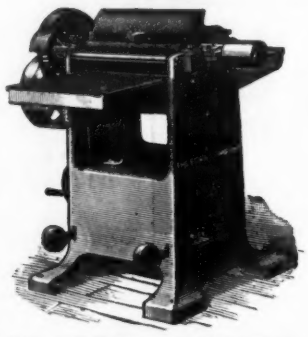

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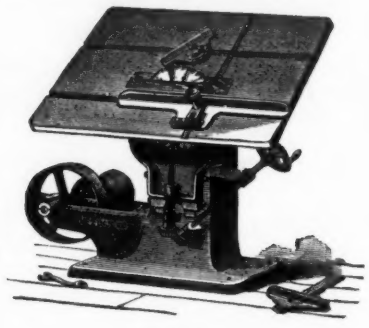

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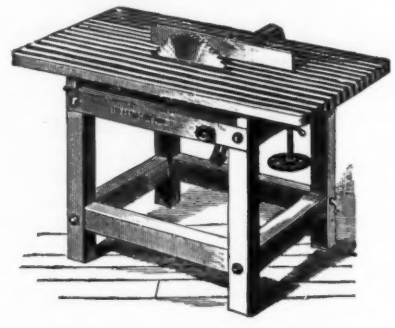

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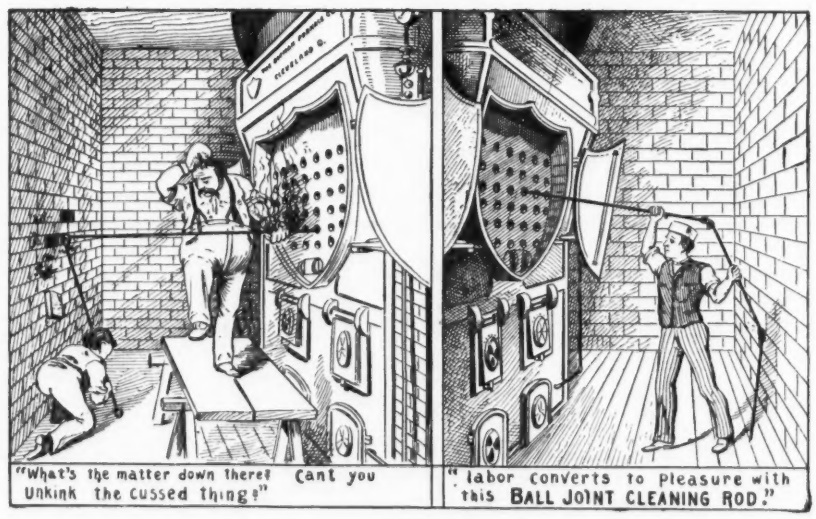
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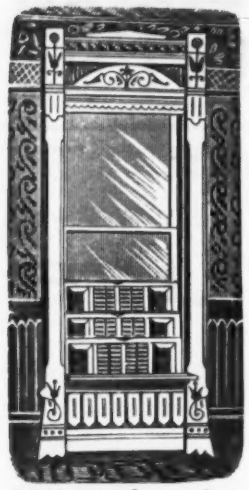

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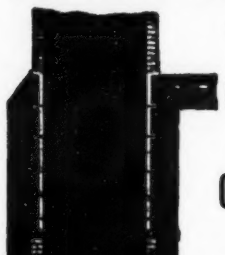

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Butt Milling Machinery, Butt Drilling Machinery Riveting Machines, Drilling and Countersinking Machines, Foot Presses, Sprue Cutters, Etc.

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Manufacturers of

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Equal to the Best English File.

OLD FILES RE-CUT.

All Kinds of Job Grinding.

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Foot & Power Lathes, Drill Presses, Scroll-Saw Attachm'ts, Mandrels, Chucks, Twist Drills, Dogs, Calipers etc. Lathes on trial Lathes on payment

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The cheapest made. Send for prices.

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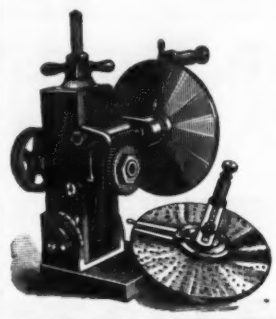

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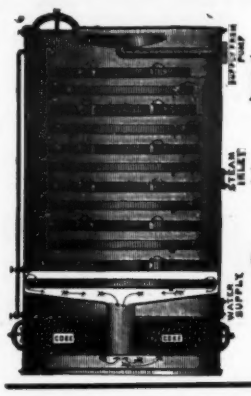

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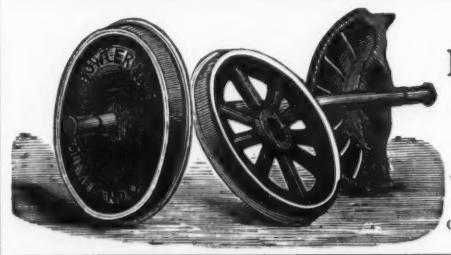

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The only Portable Folding Bath Tub made. Can be stored in space 2½x2½x6 feet.

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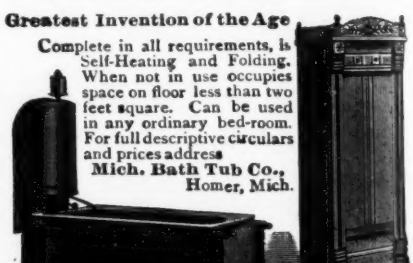

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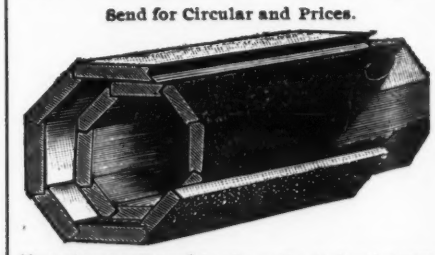

Two staves removed to show the lining between the inside and outside staves.

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CHICAGO (reported by Messrs. Rogers, Brown & Co.): Southern Coke No. 1. Foundry, $16 00 @16 50; Southern Coke No. 2 Foundry, $15 50 @16 00; Southern Coke No. 3 Foundry, $15 00 @15 50; Southern Coke No 1, Softeners, $15 50 @16 00; Southern Coke No. 2, Softeners, $15 00 @15 50; Ohio Silveries No. 1, $18 25@18 75; Ohio Silveries No. 2, $17 25@ 17 75; Ohio Strong Softeners No. 1, $19 00@19 50; Ohio Strong Softeners No. 2, $18 25@18 75; Lake Superior Charcoal Nos. 1 to 6, $20 50@21 00; Tennessee Charcoal No. 1, $19 50@20 00; Tennessee Charcoal No. 2, $19 00@19 50; Southern Standard Car Wheel, $24 00@25 00; Tennessee Standard Car Wheel, $20 00@20 50; Hanging Rock Standard Car Wheel Cold Blast, $26 00@28 00; Hanging Rock Standard Car Wheel Warm Blast, $23 00@25 00; Old Car Wheels, $00 00@00 00.

LOUISVILLE (reported by Geo. H. Hull & Co.): Southern Coke No. 1 Foundry (new classification), $14 50@14 75; Southern Coke No. 2 Foundry (new classification), $14 00@ 14 50; Southern Coke No. 3 Foundry (new classification), $13 50@14 00; Grey Forge, $13 00@13 50; White and Mottled, different grades, $12 25@12 50; Silver Grey, different grades, $13 00@14 00; Southern Charcoal No. 1 Foundry, $17 00@18 00; Southern Charcoal No. 1 Mill, $15 75@16 75; Southern Car Wheel, Standard brands, $22 50@23 00; Southern Car Wheel, other brands, $18 50@21 00; Hanging Rock Coke No. 1 Foundry, $00 00@00 00; Hanging Rock Charcoal No. 1 Foundry, $00 00@ 00 00; Hanging Rock Cold Blast, $00 00@00 00; Hanging Rock Warm Blast, $00 00@00 00.

LOUISVILLE (reported by Hall Bros. & Co.): HOT BLAST FOUNDRY—Southern coke No. 1, $14 75@15 00; Southern coke No. 2, $14 00@14 50; Southern coke No. 3, $13 50@13 75; Mahoning Valley (Lake ore mixtures), $17 50@18 50; Southern charcoal, No. 1, $17 00@17 50; Southern charcoal, No. 2, $16 50@17 00; Missouri charcoal, No. 1, $18 00@18 50; Missouri charcoal, No. 2, $17 00@17 50. FORGE—Neutral coke, $13 00@13 50; Cold short, $13 00@13 25; Mottled, $12 00@12 50. CAR WHEEL AND MALLEABLE—Southern (standard brands), $22 00@ 23 00; Southern (other brands), $18 00@19 00; Lake Superior, $22 50@23 00.

ST. LOUIS (reported by Rogers, Meacham & Shields): HOT BLAST COKE AND CHARCOAL—Southern Coke No. 1, $15 75@16 25; Southern Coke No. 2, $14 75@15 25; Southern Coke No. 3, $14 25@14 75; Southern Grey Forge, $13 75@ 14 25; Southern Charcoal No. 1, $18 00@18 50; Southern Charcoal No. 2, $17 50@18 00; Missouri Charcoal No. 1, $18 00@18 50; Missouri Charcoal No. 2, $17 50@18 00; Ohio Softeners, $18 00@ 19 50. CAR WHEEL AND MALLEABLE IRONS—Lake Superior, $22 00@23 00; Southern, $19 00@ 23 00. CONNELLSVILLE COKE—East St. Louis, $5 65; St. Louis, $5 80.

BUFFALO (reported by Rogers, Brown & Co.): Mahoning and Shenango Valley strong, No. 1 Foundry, $18 50@00 00; Mahoning and Shenango Valley strong, No. 2 Foundry, $17 50 @00 00; Niagara No. 1, $19 25@00 00; Niagara No. 2, $18 25@00 00; Niagara No. 3, $17 25@00 00; Ohio Softener No. 1, $18 50@00 00; Ohio Softener No. 2, $17 50@00 00; Lake Superior Charcoal, $21 00@00 00; Tennessee Charcoal, $20 50@00 00; Southern Softener No. 1, $16 50@00 00; Southern Softener No. 2, $15 50@00 00; Southern Strong No. 1 Foundry, $17 75@00 00; Southern Strong No. 2 Foundry, $16 50@00 00; Alabama Car Wheel, $25 00@00 00; Hanging Rock Charcoal, $24 00@00 00.

DETROIT (reported by William F. Jarvis & Co.): Lake Superior Charcoal, all Numbers, $20 75@21 25; Lake Superior (coke) Bessemer, $19 00@20 00; Katahdin (Maine charcoal), $24 00 @25 00; Lake Superior Coke, Foundry, all ore, $19 25@19 75; Lake Superior Coke, Foundry Cinder Mixed, $18 00@19 00; Standard Ohio Black Band, $18 75@19 25; Southern No. 1, $16 75@17 25; Southern Gray Forge, $14 75@ 15 00; Jackson County (Ohio) Silvery, $18 50@ 19 00; Old Car Wheel, $20 00@00 00.

PITTSBURGH (reported by A. H. Childs): No. 1 Foundry, $17 00@17 50; No. 2 Foundry, $16 00@16 50; Grey Forge, $15 00@15 50; White and Mottled, $14 25@14 50; Warm Blast Charcoal, $19 00@22 00; Cold Blast Charcoal $23 00 @29 00; Bessemer, $18 50@19 00.

CINCINNATI (reported by Rogers, Brown & Co.): FOUNDRY IRONS—Southern Coke, No. 1 foundry, $15 00@15 50; Hanging Rock Coke, No. 1 foundry, $17 50@18 50; Jackson Co. Stone Coal, No. 1 foundry, $17 00@17 50; Tennessee Charcoal, No. 1 foundry, $18 00@18 50; Hanging Rock Charcoal, No. 1 foundry, $21 00 @22 00. MILL IRONS—Standard Southern Coke, grey forge, $13 25@13 75; Standard Southern Coke, mottled, $12 75@13 25; Cold Short Southern Coke, grey forge, $13 00@13 50; Strong Ohio Neutral Coke, grey forge, $15 50@16 00. CAR WHEEL AND MALLEABLE—Standard Alabama Car Wheel, $22 50@23 00; Tennessee Car Wheel, $20 50@21 50; Lake Superior Car Wheel, $22 00@23 00.

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Flat Bar.

1½ to 4 by ⅜ to 1 inch	1 85
4½ to 6 by ⅜ to 1 inch	1 95
1¾ to 6 by 1⅛ to 2 inch	2 25
1¼ & 1⅜ by ⅜ to ¾ inch	1 95
1 & 1⅛ by ⅜ to ¾ inch	2 05
⅝, ¾ and ⅞ by ⅜ to ⅝ inch	2 25

Round and Square.

1 to 1⅜ inch	1 85
2 to 2⅜ inch	2 05
2¾ to 3¼ inch	2 35
3⅜ to 4 inch	2 85
4¼ to 4½ inch	3 35
4¾ to 5 inch	3 55

Oval.

⅜ to 1¼ inch	2 25
⅜ to ¾ inch	2 45
½	2 65
⅝	3 05

Half Oval and Half Round.

1¼ to 3 inch	2 95
⅜ to 1¼ inch	2 55
⅜ to ¾ inch	3 15
½	3 35
⅝	4 85

Heavy Band.

1¼ to 6 by ¼ and 5-16 inch	2 05
1 to 1⅜ by ¼ and 5-16 inch	2 15
¾ to ⅞ by ¼ and 5-16 inch	2 35
⅛ to ⅜ by ¼ and 5-16 inch	2 85

Hoops.

1¼ to 4, Nos. 13 to 15	2 65
1¼ to 2, Nos. 16 to 18	2 75
1¼ to 2, No. 19	2 85
1¼ to 2, No. 20	2 95
1¼ to 2, No. 21	3 05
1¼ to 2, No. 22	3 15
15-16, 1 and 1⅛, Nos. 13 to 15	2 85
15-16, 1 and 1⅛, Nos. 16 to 18	2 95
15-16, 1 and 1⅛, Nos. 19 and 20	3 05
15-16, 1 and 1⅛, No. 21	3 15
15-16, 1 and 1⅛, No. 22	3 25
⅞, Nos. 13 to 15	3 05
⅞, Nos. 16 to 18	3 15
⅞, Nos. 19 and 20	3 25
⅞, No. 21	3 35
⅞, No. 22	3 45
13-16, Nos. 13 to 15	3 25
13-16, Nos. 16 to 18	3 35
13-16, Nos. 19 and 20	3 45
13-16, No. 21	3 55
13-16, No. 22	3 65
¾, Nos. 13 to 15	3 35
¾, Nos. 16 to 18	3 55
¾, Nos. 19 and 20	3 65
¾, No. 21	3 75
¾, No. 22	3 85
11-16, Nos. 13 to 15	3 55
11-16, Nos. 16 to 18	3 75
11-16, Nos. 19 and 20	3 85
11-16, No. 21	3 95
11-16, No. 22	4 05
⅝, Nos. 13 to 15	3 85
⅝, Nos. 16 to 18	4 05
⅝, Nos. 19 and 20	4 15
⅝, No. 21	4 25
⅝, No. 22	4 35
⅝, No. 23	4 55

Light Band.

1⅛ to 6 by ⅛ to 3-16 in	2 25
1⅛ to 6 by Nos. 11 and 12	2 35
1 to 1¾ by ⅛ to 3-16 in	2 45
1 to 1⅜ by Nos. 11 and 12	2 55
⅞ and 13-16 by ⅛ to 3-16 in	2 75
⅞ and 13-16 by Nos. 11 and 12	2 85
¾ and 11-16 by ⅛ to 3-16 in	3 05
¾ and 11-16 by Nos. 11 and 12	3 15
⅝ and 9-16 by ⅛ to 3-16 in.	3 35
⅝ and 9-16 by Nos. 11 and 12	3 45
½ by ⅛ to 3-16 in	3 65
½ by Nos. 11 and 12	3 75

Wagon Box Iron.

⅞ inch, beveled edge, by Nos. 11 and 12	2 85
⅞ inch, " " " 13 and 14	3 05
¾ inch, " " " 11 and 12	3 15
¾ inch, " " " 13 and 14	3 35

Sheet Iron.

No. 10 to 14	2 65
No. 15 to 17	2 80
No. 18 to 21	3 00
No. 22 to 24	3 20
No. 25 to 26	3 35
No. 27	3 45
No. 28	3 55

Iron Boiler Plates.

Tank, ¼ inch and heavier	2 80
C No. 1, " "	3 05
C H No. 1 " "	3 30
C H Flange, " "	4 05
Extra Flange, "	4 55
Solid Fire Box "	5 30

Steel Boiler Plates—1-4 in. and Heavier.

Tank	3 00
Shell	3 40
Flange	3 70
Marine Flange	4 10
Fire Box	4 80

Above includes plates 90 inches wide.

90 to 96 in. wide	⅛c ℔ extra
96 to 100 in. wide	1 c "
100 to 104 in. wide	1⅛c "
104 to 116 in. wide	special

American Cast Tool Steel.

ROUND, SQUARE AND OCTAGON.	cts. ℔s
1 to 2 in. inclusive	09
9-16 to ⅞ in "	09
7-16 to ⅜ and 2⅜ to 3 in	10½
3⅛ to 4 in	11
⅞ to 11-16 and 4⅛	10½
⅛ to 6 in	11½
¼ to 9-32 and 6⅛ to 7 in	12
3-6 in	14

Flats.

	cts. ℔s
2 to 9-16 wide by 2 to ⅛ thick	0

Bessemer and O. H. Steel.

Machinery	base price,	3 00
Tire	"	3 00
Spring	"	3 50
Sleigh Shoe	"	3 00
Toe Calk	"	3 25
Cutter Shoes, tapered and burr.	"	3 25

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Jessop's	16c
Hobson's "Best"	16c
" "Choice"	36c

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½, ⅝, 11-16 and ¾ inches diameter	4 00
Bridge ½, ⅝, 11-16 and ¾ inch diam	4 00

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No. 1 R. R. wrought scrap	$18 00
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Iron axles	22 00
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Wrought turning (free from cast)	12 00
Cast borings	9 00
Uncut wrought iron boilers	13 00
Steel boiler plates	17 00
Grate Bars	9 00
Pipes and flues (Clean)	12 00
Tank iron	12 00
Hoop and band iron	9 00
Sheet iron	10 00
Wrought drillings	11 00
Malleable iron	10 00

GROSS TONS	
Old iron T rails	22 50
Old steel rails	19 50
Old car wheels	18 50
Old copper	℔ 10
No. 1 H. red Brass	11
Heavy yellow brass	8½
Light yellow brass	6
Scrap Zinc	
Tea Lead	
Heavy Lead	3¼

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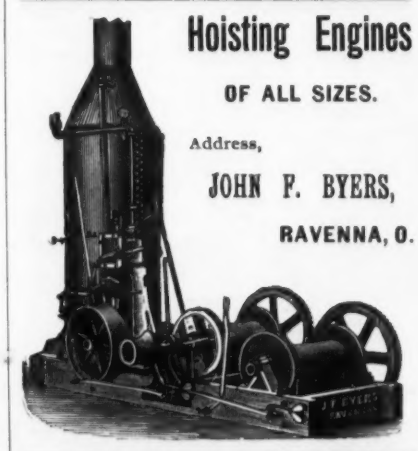

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American.....₩ lb 9@10
Wrights.....₩ lb 9¼

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Blacksmiths' { Hill's.....dis 40 / Bullock's.... dis 50&10
Moulders'.....dis 40@40&10
Hand.....dis 40&10@50

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Boston Belting Co's standard.....dis 70@70& 5
" " " extra.....dis 60&5@60&10
" " " best.....dis 55
Hoyt's Short Lap.....dis 45
Cleveland Rubber Co. extra standard.dis 60&10
Shultz Raw Hide Leather Belting, single, ...dis 40
Shultz Raw Hide Leather Belting, double, and Light Double.....dis 40
Standard, oak tanned.....dis 50@60
Alexander Brothers' pure oak tanned. ...dis 45

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B. F. Sturtevant's.....dis 20
Boston Blower Co.,.....dis 35
Buffalo.....dis 35

Borax.

.....₩ lb 9¼@10¼

Chalk.

White .....₩ gross 50
White Crayon.....₩ gross 12@12½ dis 10
Red.....dis 70
Blue.....dis 85

Chucks.

Cushman's 4 Jaw Independent.....dis 45
" Combination.....dis 40
" Geared Scroll.....dis 30
" 2 Jaw Brass Workers. .....dis 30
" Drill.....dis 35
Wescott's Scroll Combination.....dis 33⅓
" Independent.....dis 40
" Little Giant Drill.....dis 30
Horton's Universal.....dis 40
" Independent.....dis 45
National Combination.....dis 40
Sweetland " .....dis 40
Skinner " .....dis 40
" Independent.....dis 45
Almond Drill.....dis 20
Morse " .....dis 15
Skinner " .....dis 30

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Cleveland.....dis 10@15
Pratt & Whitney.....dis 10@15
Standard.....dis 10@15
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" " Gear Cutters.....dis 15

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Cast Steel.....₩ lb 4
Iron, steel points.....₩ lb 3¼

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Twist drills.....dis 50&10
Morse Taper and Straight shank to 1½".....dis 50&10
Morse Taper and Straight shank Larger than 1½".....dis 25
Drill Sockets.....dis 25
Standard.....dis 55@55&5
Cleveland.....dis 55@55&5

Emery.

	No. 4 to 46 gr.	No. 54 to 150. gr.	Flour, F.	C. F. FF.
Kegs, ₩ lb	4 c	5 c		2½c
½ kegs ₩ lb	4½c	5½c		2¾c
¼ kegs ₩ lb	4¾c	5¾c		3 c
10 lb cans, 10 in case	6 c	6¾c		5 c
10 lb cans, less than 10	10 c	10 c		7½c

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Barder, Adamson & Co.....dis 45@50
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Detroit.....dis 55@60
Norton's.....dis 55@60
Grant.....dis 55@60
Sterling.....dis 60
Celluloid.....dis 10&33⅓
Northampton.....dis 55
Crystal.....dis 65@70
Vitrified.....dis 60
Vulcanite.....dis 10&10

Files.

Nicholson.....dis 60&10@60&10&10
" X. F.....dis 25
Kearney & Foot.....dis 60&10@60&10&10
Black Diamond.....dis 60&10@60&10&10
Arcade.....dis 60&10@60&10&10
Disston's.....dis 65@70
Western.....dis 70
Stub's.....dis 25
Grobet's.....dis 30
Reynolds Bros.' Hand Cut.....dis 50

Hammers.

P. S. W.....dis 40
Atha new list, Jan. 15, 1887.....dis 50
Heavy hammers and sledges under 5 lbs. 18c over 5 lbs 14c, new list.

Jack Screws.

Illinois Bolt Co. list.....dis 70

Nuts and Washers.

Size of bolt inches	¼	5-16	⅜	½	⅝	¾	1
Square	8	7	5½	4¾	4	3¼	3⅛
Hexagon	15¼	11¼	8¼	6	5¼	5¼	5
Washers	9	8	7	5	4½	4½	4½

In lots less than 100 lbs, ₩ lb add ½c., 1lb boxes add 1c to list.

Nails (wire.)

List July 14, 1887.....dis 70 &10
Standard Penny Nails, ₩ keg card rate { Car lots.....$2.30 / Less than car lots $2.40

Oilers.

Zinc and Tin.....dis 60
Brass and Copper.....dis 50
Malleable (Hammer's), No. 1, $3.60; No. 2, $4.00; No. 3, $4.40 ₩ doz.....dis 70@10&10

Packing, Steam.

Boston Belting Co.....dis 60
American Packing Hemp.....₩ lb 10@11
Russia Packing " .....₩ lb 14
Italian Packing " .....₩ lb 13@14
Plumbago Piston.....₩ lb 40
Morrison's " .....₩ lb 50
Square Flax " .....₩ lb 50
Sheet Rubber.....₩ lb 12@24
Excelsior Rubber.....₩ lb 24

Picks.

Railroads, 5 to 6 lbs.....$12 dis 60
" 6 to 7 lbs.....$13 dis 60

Pulleys.

Iron Pulleys, Walker List.....dis 45
Medart Pulleys.....dis 55
Split Wood Pulleys.....dis 55

Rivets.

Iron, Thousand, list November 17, ...dis 50
Iron, Ordinary, Cooper's Block and Carriage list November 17.....dis 50
Copper.....dis 50@50&10

Rope.

Manilla, ½ inch and over.....₩ lb 13¾
Sisal, ½ inch and over .....₩ lb 13¼

Sand Paper.

B. A. & Co.....dis45@50
H. H. Barton's.....dis40@45
New England Flint.....dis 40@50
Barton's Garnet.....dis 20

Saws.

Disston's Circular.....dis 45
" Band.....dis 20
" Scroll .....Net
Hack Saw Stubs.....dis 20
" " Eureka.....dis 20
" " Star.....dis 20
Saw Swages Disston's.....dis 20
Atkins' Cicular Saws.....dis 50
" Mill, Mulay and Drag Saws..dis 40&10
" Wood Saws.....dis 40&10
" Silver Steel Diamond Cross-cut Saws.....dis 70c per ft
" Dexter Cross-cuts.....dis 50c "
" Diamond " .....dis 30c "
" Tuttle Tooth Cross-cuts..dis 25c "
" One-man Cross-cuts.....dis 32c "
No. 1 Handles.....dis 23c per pair
No. 6 " .....dis 16c "
Excelsior Saw Tools.....$6 per doz
Perfection " .....$15 "
Detroit Saw Works, Circular.....dis 50
" " " Band.....dis 25
" " " Mulay .....dis 45

Screws.

Wood Screws—List Jan 27, 1889.

Flat head iron.....dis 50
Round head iron.....dis 40
Flat head brass.....dis 45
Round head brass.....dis 35
Square Cap.....dis 65
Hexagon Cap.....dis 60
Set C. H. C. P.....dis 70
Machine, flat head, iron.....dis 65
Machine, round head, iron.....dis 60
Bench and hand—
Lag or coach.....dis 75@75&10
Coach, patent gimlet point.....dis 75

Shovels and Spades.

Ames' list November 1, 1885.....dis 20
Dennis.....dis 5.25
Hussey & Binns, railroad.....dis 8.00

Taps.

Cards, Hand and Nut to 2 in.....dis 50
Carpenters' " " " .....dis 50
Morse " " " .....dis 50
Pratt & Whitney " " new list dis 10
Machine Screw Taps.....dis 55
Pipe Taps to 2½ in.....dis 70
Stay Bolt Taps.....dis 25
Stove Bolt Taps.....dis 50
Pulley Taps.....dis 40

Twine.

	BC.	B.
No. 12, Flax Twine, ¼ and ⅛ lb Balls	21c@29c	
No. 18 " " ¼ and ⅛ "	18c@28c	
No. 36 " " ¼ and ⅛ "	16c@27c	
2-Ply Hemp, ¼ & ⅛ lb Balls (Spring Twine)	11½c	
3-Ply " 1lb Balls	12@12½c	
3-Ply " 1½ lb Balls	11@11¼c	
Cotton Wrapping, 5 Balls to lb	15@16c	

Vises.

Solid Box.....dis 60
Parker's.....dis 20@25
Prentiss.....dis 20
Stephen's.....dis 25@30
Barrett's.....dis 30
Miller's Falls.....dis 40
Merrill's.....dis 10@15
Howard.....dis 30

Wire.

New List, Jan. 18, 1884

Brass and copper.....dis 20@25
Bright and annealed, Nos. 0@18...dis 70&10@75
" " Nos. 19@26..dis 75@75& 5
" " Nos. 27@36..dis 75&10& 5
Coppered Nos. 0 to 18, market list..dis 70@70& 5
Galvanized Nos. 0 to 18 " " .....dis 65&5
Tinned market Nos. 0 to 18.....dis 67½
Cast steel.....dis 50
Tinned Broom Wire.....dis 70&5@70&10
Annealed Fence, Nos. 8 and 9.....dis 75
Annealed Grape, Nos. 10 to 14.....dis 75
Stub's Steel Wire regular.....$6.00@lb dis 30

Wrenches.

Coe's genuine, cash in ten days.....dis 50
Girard Standard.....dis 70&10
Agricultural.....dis 75&10
Mechanics'.....dis 55&10,& 3
Bemis & Call's Combination .....dis 35
Donohue's Engineers.....dis 20&10
Lamson & Sessions Engineers.....dis 60
Billings & Spencer's Drop Forged.....dis 10
William's " " .....dis 10
Alligator " " .....dis 40

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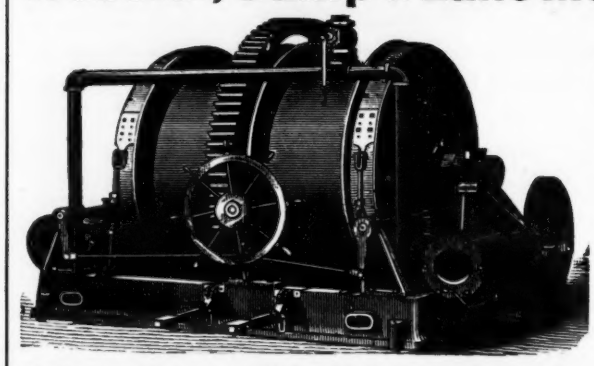

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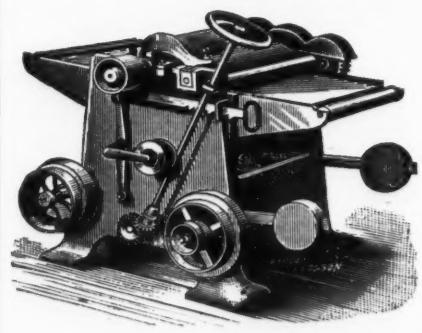

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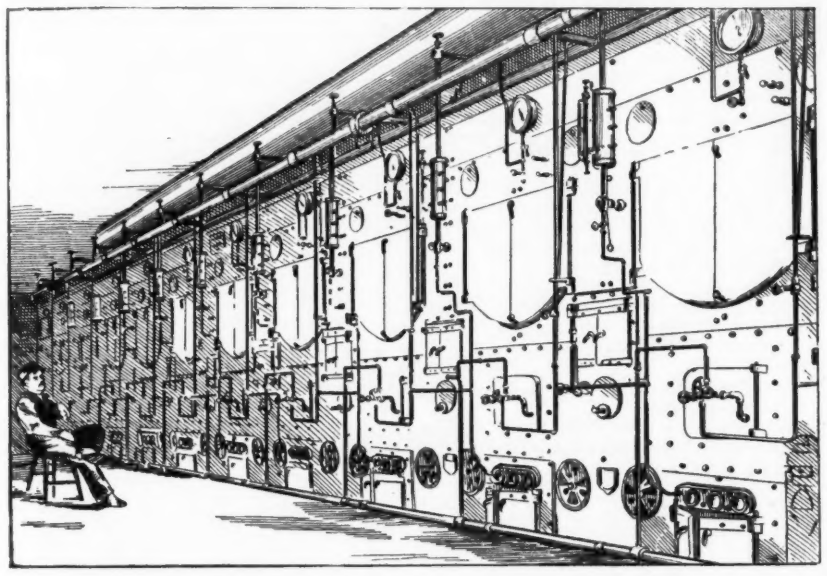

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Augers and Bits.

Common augers and bits.....dis 70
Snell's.....dis 60&5
Cook's Douglass Mfg. Co.....dis 55
Russell Jennings' augers and bits.....dis 25
Expansive Bits, Clark's small, $18; large, $26.....dis 35@35&5
Hollow Augers, Ives'.....dis 25&10
Hollow Augers, Bonney's Adjust. ₩ doz., $48.....dis 40&10
Hollow Augers, Stearns' Adjust. ₩ doz., $48.....dis 20&10
Gimlet bits, common.....per gross $2 75@3 25
Standard Bit Stock Drills.....dis 50&10&5
Ship Augers.....dis 15&10@15&10&5

Axes.

Makers' and Special Brands—
First quality.....₩ doz $8 00
Others.....₩ doz $7 00
Full polished.....₩ doz $9 00

Bolts.

Cast iron barrel bolts.....dis 70
Cast iron shutter bolts, etc.....dis 70
Cast iron chain bolts.....dis 65&10
Ives' patent door bolt.....dis 60
Wrought iron barrel bolts.....dis 70
Wrought iron square bolts.....dis 70
Wrought shutter bolts.....dis 60&10

Sargent's list
Carriage, common, new list.....dis 70&12½
Tire, common, new list.....dis 70
Carriage and tire, Philadelphia pattern.....dis 75&10
Stove bolts.....dis 60
Plow bolts.....dis 60&5
Machine.....dis 75&10@80
Ends.....dis 75&10&80

Buckets, Elevator.

.....dis 50&10

Butts.

Wrought brass.....dis 75&10
Cast brass, loose joint.....dis 33⅓
Cast Iron—
Fast joint, narrow.....dis 50&10&5@60&5
Fast joint, broad.....dis 55&10&5@60&10
Loose joint.....dis 70
Loose joint, jap.....dis 70
Loose joint, jap. with acorns.....dis 70
Loose pin, acorns.....dis 70
Loose pin, japanned acorns.....dis 70
Loose pin, acorns, jap. plated tips.....dis 70
Wrought steel—
Wrought, fast joint, narrow.....dis 70
Wrought, fast joint, broad.....dis 70
Wrought, loose joint, broad.....dis 70
Table Butts, back flaps, etc.....dis 70
Regular inside blind.....dis 70
Light inside blind.....dis 70
Loose pin.....dis 70
Light loose pin.....dis 70

Chains.

Trace, 6¼-10-2.....₩ pair 1.03
Trace, 6¼-10-3.....₩ pair .92 } 50&10@50&10&5
Trace, 7-10-2.....₩ pair 1.11
German Halter Chain, list June, 1887...dis 50&10
German Coil, list of June, 1887..dis 50&10&5@60
Galvanized Pump Chain.....₩ 5¼@6
Jack Chain, Iron.....dis 75@75&5
Jack Chain, Brass.....dis 70@70&5

Chisels.

Socket Framing and Firmer.....dis 75
Socket Framing and Firmer, Buck Bros..dis 30
Socket Firmer and Framing, L. & I. J. White.....dis 30@30&5
Tanged Firmers.....dis 40&10

Cutlery.

Table.....net
Excelsior Pocket.....net

Fibre Ware—Standard.

	Nos. 1	5.	5X.
Pails, water, 12 qt	$4 00	$4 50	$.....
Dairy, 14 qt	4 50	5 00	.....
Fire 12 qt	5 00	.....	.....
Sugar	6 00	6 50	.....
Horse	.....	5 00	.....
Buggy	4 00	.....	.....
Chamber, Slop, Commode } 5 and 5X 14 qt.	6 50	7 50	8 50
Jars, slop, 5 and 5X 14 qt	8 00	9 00	10 00
Basins, wash—			
10½ inch	2 00	2 25	.....
12 inch	2 25	2 75	3 25
13½ inch	2 75	3 25	3 75
15 inch	3 25	3 75	4 25
Bowls, fruit	.....	2 50	.....
Servers, 12 in	.....	2 25	.....
Baskets, waste paper, 13 in	.....	6 00	.....
Spittons, "Daisy," pressed			
8 inch	4 00	4 50	5 00
10 and 11½ inch	6 00	6 50	7 50

No. 1 plain; No. 5 decorated; No. 5X White decorated.

Gimlets.

Nail and Spike.....dis 50&10&5
Double cut, low list.....dis 25
"Bee".....₩ gross $12, dis 25@25&5

Hangers.

Barn door, old patterns.....dis 10&10@70
Climax, (Anti-Friction).....dis 70
Star.....dis 40&10@40&10&5
Scranton.....dis 40
Kidder's.....dis 50&10@60
Terry's Patent.....5 in., $12; 4 in., $10, dis 50&5
Paragon.....dis 40&10
Richard's.....dis 30@30&10

Horse Nails.

No.	10	9	8	7	6	
Ausable, ₩ lb.	23	24	25	26	28	dis 25&10@25&10&10
Putnam, ₩ lb.	18	19	20	21	23	dis 15
Essex						dis 25&10@25&10&10

Horse Shoes.

Burden, at factory.....₩ keg $4 00
R. I. Horshoe Co., Perkins' Imp. at factory.....₩ keg $4 00
Mule Shoes, at factory.....₩ keg $5 00

Knobs.

Carriage, japanned.....₩ gross 80c dis 60&10
Base, rubber tip.....dis 70&10&5
Hematite door knobs, new list.....dis 40&10@50
Door mineral.....dis 65c@68c
Door Por. japanned.....dis 75c@78c
Door Por. nickle.....$2 00@2 25
Door Por. plated.....$2 00@2 25

Locks, Bolts, Etc.

P. & F. Corbear, Locks and Bronze Goods.
Door locks, knobs and latches.....dis 60
Escutcheons and keys.....dis 60
Padlocks and padlock keys.....dis 66⅔
Bell pulls, mineral, porcelain and jet.....dis 60
Bell pulls, genuine bronze.....dis 60&10
Lever bell pulls, genuine bronze.....dis 60&10
Butts', genuine bronze.....dis 60&10
Butts' bronze plated.....dis 60&10
Store door locks and latches.....dis 60&10
Store door handles.....dis 60&10
Shutter hinges&flaps, genuine bronze.dis 60&10
Shutter hinges, bronze plated.....dis 70
Flush bolts, genuine bronze.....dis 70
Shutter knobs, genuine bronze.....dis 50
Shutter bars, genuine bronze.....dis 60
Sash lifts, genuine bronze.....dis 60
Sash pulls and plates, genuine bronze.....dis 60
Push plates, genuine bronze.....dis 60
Drawer pull, genuine bronze.....dis 66⅔
Letter box plates, genuine bronze....dis 60&10
Barn door locks.....dis 33⅓
Bishop's Buckeye Sash Locks.....₩ gross $4.80

Plumbs and Levels.

Standard list.....dis 70&10@70&10&10
Pocket levels.....dis 70&10@70&10&10
Davis' inclinometers.....dis 10&10

Pumps.

Cistern, best makers.....dis 50&10@00
Pitcher spout, best makers dis 60&10@60&10&10
Pitcher spout, cheaper goods dis 70&5@70&10&5

Pokes, Animal.

Bishop's I. X. L.....₩ doz $6 00
Bishop's O K.....₩ doz $5 25
Bishop's Pioneer.....₩ doz $3 75
Bishop's American.....₩ doz $2 75

Rakes.

Cast steel.....dis 65&5
Malleable.....dis 70@70&5

Razors.

J. R. Torrey Razor Co.....dis 20
Wostenholme & Butcher.....$10@36...dis 10
Rifle razor.....dis $9 50 net

Rat Killers.

Schuyler's.....₩ gross $15 00

Scales.

Hatch, Counter, No. 171.....₩ doz $21 00
Hatch, Tea, No. 161.....₩ doz $6 75@7 00
Chatillon's Grocers.....dis 50
Family Turnbulls.....dis 30@30&10
Scale Beams, List of January 12, 1882.....dis 50&10@50&10&4

Screw Drivers.

Stanley R. & L. Co.'s Varnished Handles.....dis 65&10
Stanley R. & L. Co.'s Black Handles..dis 60&10
Sets interchangeables.....₩ doz $18 dis 25

Squares.

Steel and iron, Nickel plated } dis 75&10@80
Disston's try square and T bevels.....dis 45&10
Winterbottom's try and miter.....dis 30&10

Tacks, Brads, Etc.

New List, January 2, 1888.

American iron carpet tacks all kinds dis 70&5
Steel carpet tacks all kinds.....dis 70&5
Swedes iron carpet tacks, all kinds.....dis 70&5
Swedes iron tacks.....dis 70&5
Swedes iron Upholsterers' tacks.....dis 70&5
Tinned Swedes iron tacks.....dis 70&5
Tinned Swedes iron Upholsterers' tacks.....dis 70&10
American iron cut tacks.....dis 67½&5
Copper tacks.....dis 50
Copper finishing and trunk nails.....dis 50&00
Cigar box nails.....dis 45&10
Finishing nails.....dis 65
Hungarian nails and miners' tacks.dis 62½&5
Gimp and lace tacks.....dis 70&5
" " " tinned.....dis 66&10
Trunk and clout nails.....dis 66⅔
Tinned trunk&clout nails.....dis 66&10
Basket nails.....dis 66&10
Chair nails.....dis 66&10
Common and patent brads.....dis 66&10
Tinned capped trunk nails.....dis 60

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1 25	"	Plain, center crank	260
1 20	"	Plain, center crank	240
1 20	"	Plain, side crank	180
1 16	"	Plain, center crank	180
1 14	"	Plain, side crank	100
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75	H.-P.	Tubular	$500
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4	"	Vertical Boiler and Engine,	115
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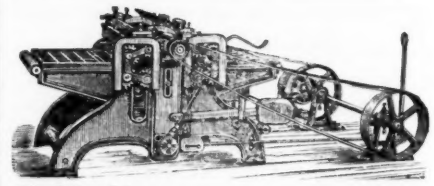

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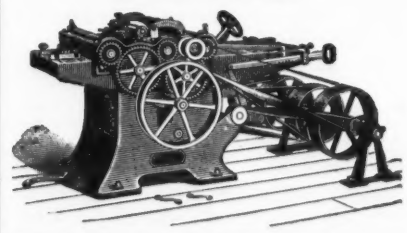

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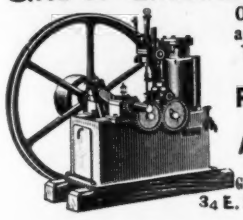

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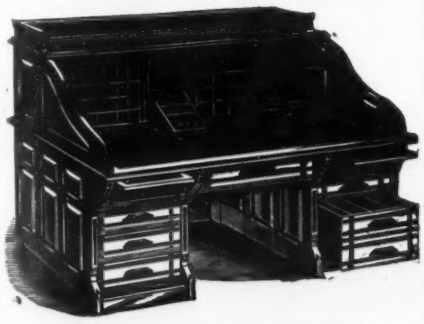

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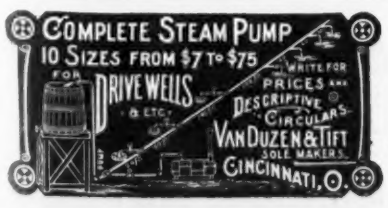

TRAVELERS' REGISTER.

Standard Time.

Erie Railway.

Depot, South Water Street and Viaduct.

	Arrive.	Depart.
N. Y. & Pitts. Express.....	‡5 38 a m	*8 25 a m
Fast N. Y. & Pitts. Express	*10 55 a m	*3 00 p m
Mahoning Accommo.....		†6 40 a m
Pittsburgh Express.....	†6 25 p m	
Youngstown Local.....	†8 05 a m	
Mahon'g div. & Pitts Local		*11 40 a m
Mahoning Val. Accom.....		†4 30 p m
Pittsburgh Express.....	†1 20 p m	11 10 p m
New York Express.....	*8 00 p m	.....

*Daily. †Daily, except Sunday. ‡Daily except Monday.

Cleveland & Canton Railroad.

(Standard Gauge.)

Depart for—

Zanesville and Coshocton—6:50 a. m., 3:00 p. m.
Canton—6:50 a. m., 3:00 p. m., 6:20 p. m.
Kent—6:50 a. m., 3:00 p. m., *5:45 p. m. 6:20 p. m.
Bedford—6:50 a. m., 11:10 a. m., 1:30 p. m., 3:00 p. m., 4:40 p. m., *5:45 p. m., 6:20 p. m. 10:35 p. m.
Newburgh—6:15 a. m., 6:50 a. m., 11:10 a. m., 1.30 p. m., 3:00 p. m., 4:40 p. m., *5:45 p. m., 6:20 p. m., 10:35 p. m.

Arrive from—

Zanesville and Coshocton—10:30 a. m.,6:30 p. m.
Canton, 10:30 a. m., 2:35 p. m., 6:30 p. m.
Kent—*8:10 a. m., 10:30 a. m., 2:35 p. m., 6:30 p.m.
Bedford—6:00 a. m., *8:10 a.m., 10:30 a.m., 1:05 p. m., 2:35 p. m., 4:15 p. m., 6:30 p.m., 7:10 p.m.
Newburgh—6:00 a. m., 7:15 a. m., *8:10 a. m., 10:30 a. m., 1.05 p. m., 2:35 p. m., 4:15 p. m., 6:30 p. m., 7:10 p. m.

Trains marked * run daily.

Valley Railway.

FOR AKRON, CANTON AND MARIETTA.

Depot foot South Water Street.

	Depart.	Arrive.
Valley Junction Mail.....	*7 45 a m	*6 25 p m
Marietta Express.....	†11 15 a m	†2 25 p m
Valley Junction Express...	*4 15 p m	*10 25 a m
Cleve. and Canton Express	*7 05 p m	†8 20 a m

*Daily. †Daily, except Sunday.

J. T. JOHNSON, Gen. Supt. J. B. CAVEN, Gen. Pass. Agt.

From Cleveland Union Station.

PENNSYLVANIA LINES.

Cleveland & Pittsburgh R. R.

	Depart.	Arrive.
For Pittsburgh, Baltimore, Washington, Philadelphia and New York.	8 00 a m	d5 25 a m
	1 15 p m	12 50 p m
	d11 10 p m	6 35 p m
Wheeling and Bellaire.	8 00 a m	12 50 p m
	1 15 p m	6 35 p m
	*11 10 p m	.....
Alliance Accom.	3 25 p m	9 40 a m
Ravenna Accom.....	5 00 p m	8 25 a m

d Daily. *Except Saturday. Other trains except Sunday.

From Cleveland Union Station.

Mt Vernon and Pan Handle Route

Cleveland & Pittsburgh R. R.

	Depart.	Arrive.
For Cuyahoga Falls, Akron, Orrville, Millersburg, Gambier, Mt. Vernon, Columbus. Xenia, Dayton, Cincinnati, Louisville, Indianapolis, St. Louis, and all points in the South and Southwest.	8 10 a m	d 7 00 am
	d 8 00 p m	5 40 p m
For Cuyahoga Falls, Akron, Orrville, Millersburg, Gambier, Mt. Vernon and Columbus.	1 15 p m	12 50 p m
For Cuyahoga Falls, Akron, Orrville, Chicago, and all points in the West and Northwest.	8 10 a m	5 40 p m
	3 25 p m	9 35 a m

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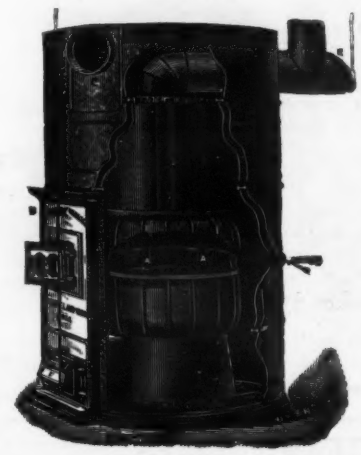

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No. 71, Youngstown Accom.....	* 7 15 a m
No. 65, New York & Pitts. Lim.....	* 9 55 a m
No. 67, Pittsburgh Accom.....	*12 45 p m
No. 73, Leavittsburgh Local.	* 2 10 p m
No. 63, New York & Pitts. Ex.....	* 6 50 p m
No. 75, Mantua Accom.....	* 7 20 p m
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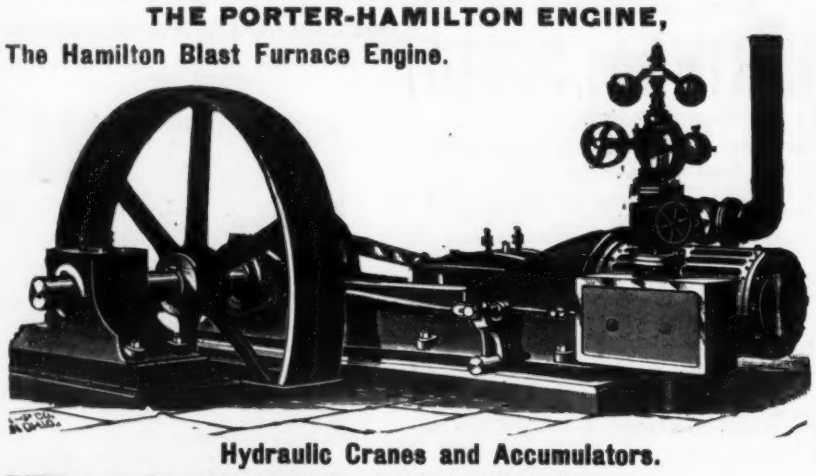

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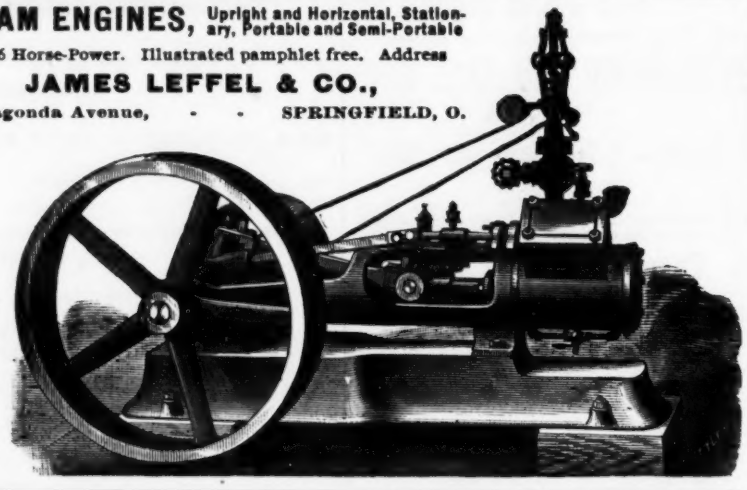

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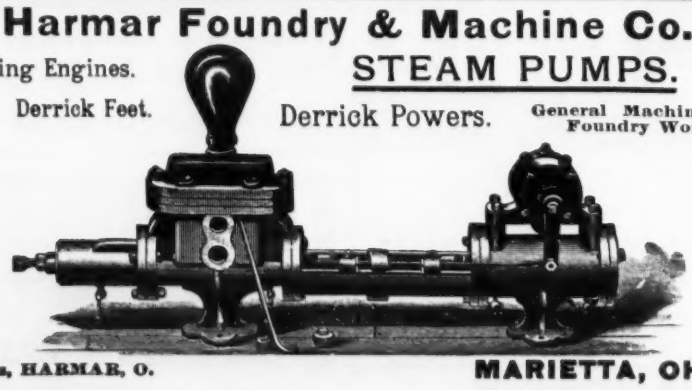

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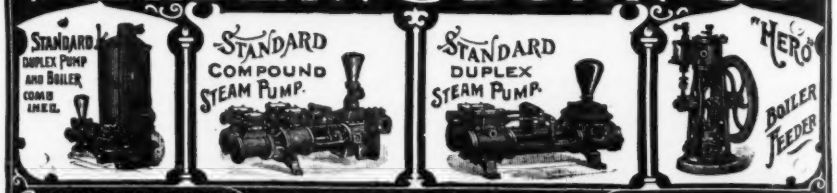

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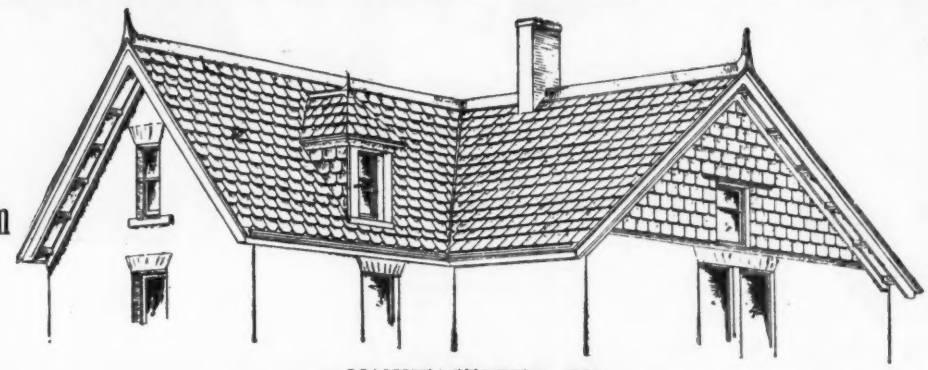

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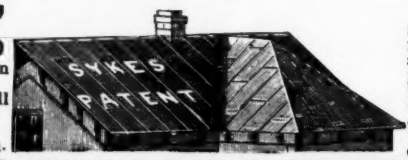

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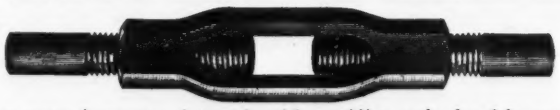

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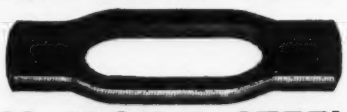

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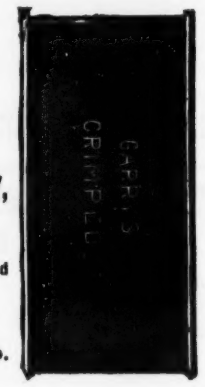

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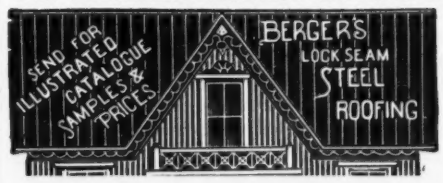

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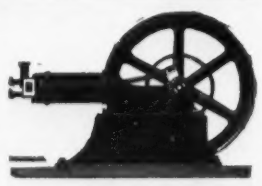

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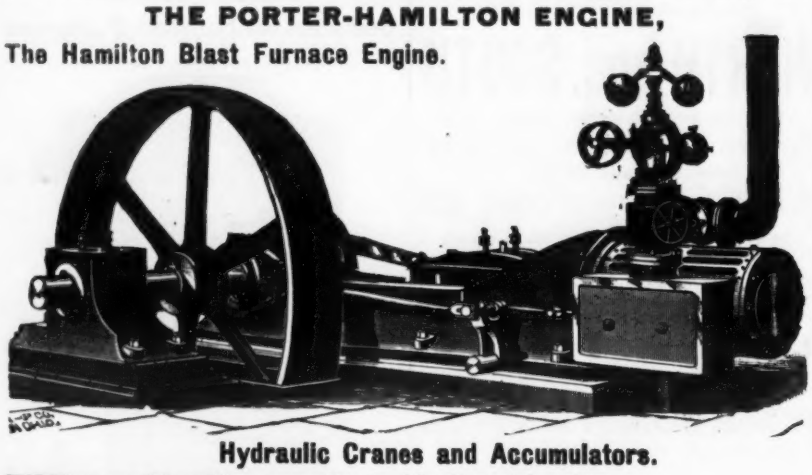

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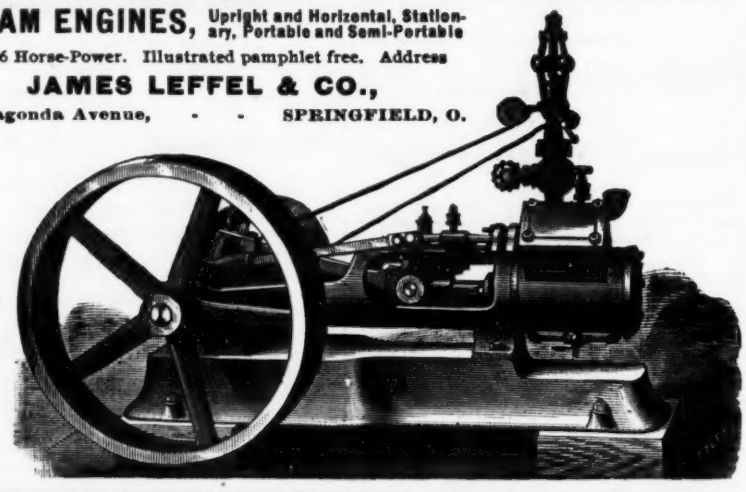

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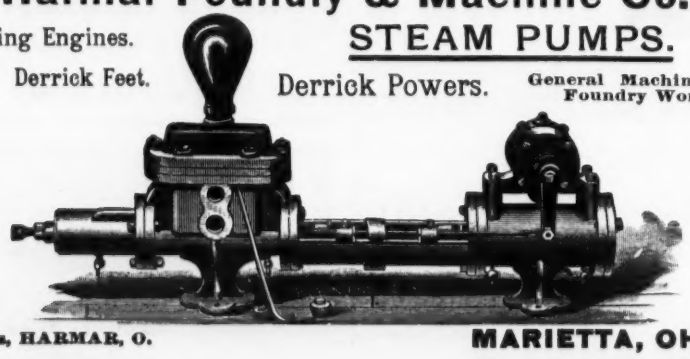

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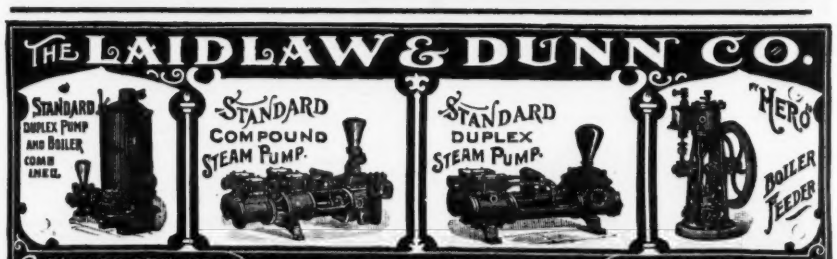

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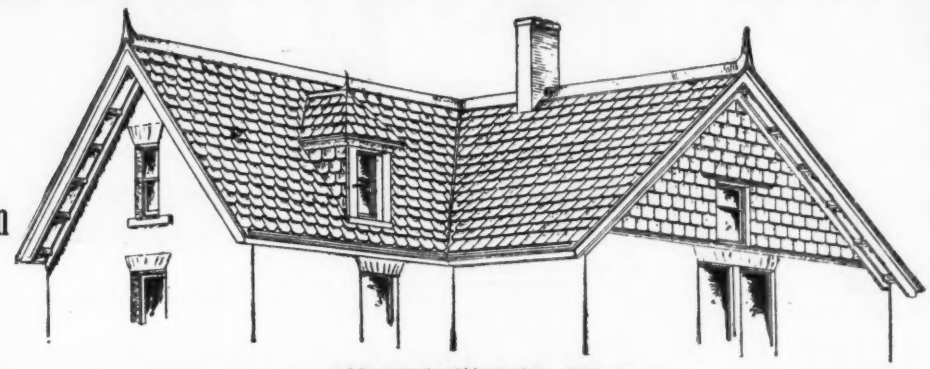

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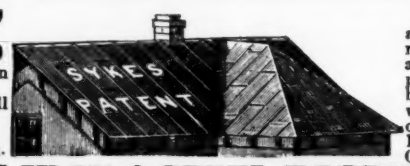

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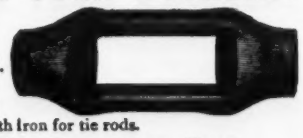

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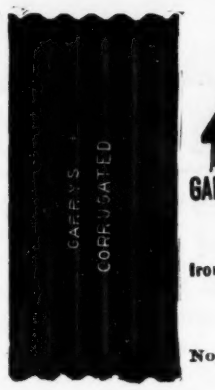

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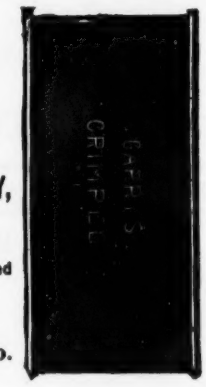

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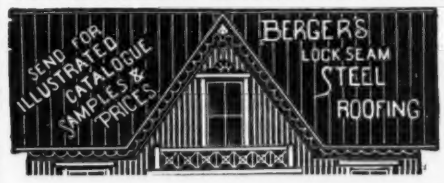

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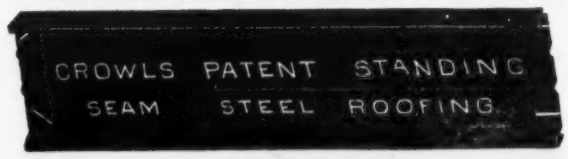

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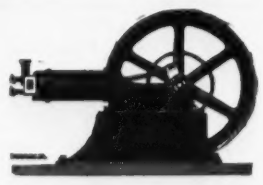

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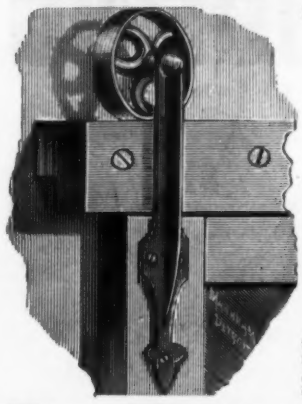

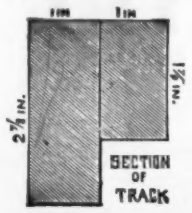

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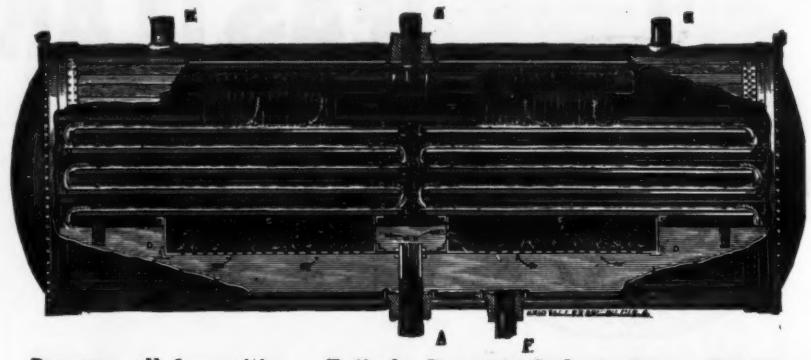

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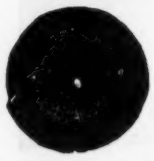

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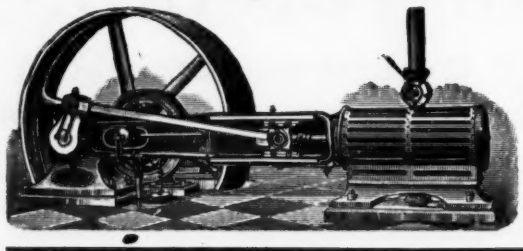

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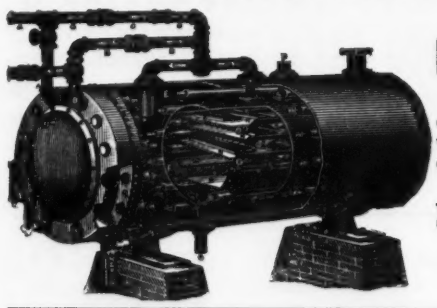

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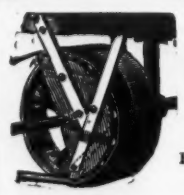

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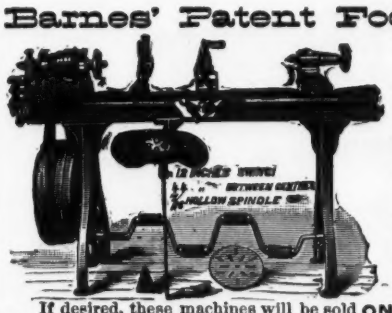

Our Patent Velocipede Foot-Power is without question the best yet applied to Lathes. Read a few expressions from those using them: "I do not see how your lathes can be produced at so low cost." "The velocipede foot-power is simply elegant." "Can turn a whole day, and feel as little tired as though only walking around." "In regard to the velocipede foot-power, I consider the lathe without an equal." "I sat at the lathe for 11 hours, cutting off and threading 1¼ steam pipes. Those who saw it declared it equal to 15 hour job in machine shop." "Using the velocipede foot-power, the operator can hold a steady hand for doing the work." "For doing actual business, the lightest or the heaviest, give me the velocipede foot-power." "The 4½ Lathe is equal to any costing twice the money." "What astonishes me is, how you can make machines to pay you for so small sum of money." "The No. 6 Lathe is the most perfect tool I ever saw for the money." "I can do double the amount of work on the velocipede, that I can on any other style of foot-power lathe." "There is no tax on strength, the body is at rest, steady, the hands and attention free for the job." "The velocipede.—It is the best foot-power of any for lathes."

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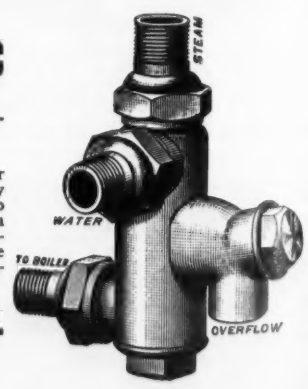

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